

VIETNAM NATIONAL UNIVERSITY HO CHI MINH CITY  
HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY  
FACULTY OF COMPUTER SCIENCE AND ENGINEERING



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# Software Requirements Specification for Smart Printing Service for students at HCMUT

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Version 1.0 approved

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## Revision History

Name	Date	Reason for Changes	Version
Lê Quốc Bảo	13/09 - 22/09	Task 1.1, 1.2. Requirement elicitation and analysis. Includes domain description, stakeholder analysis, functional, and non-functional requirements.	1.0
Mai Hoàng Phúc, Lưu Bảo Long	22/09 - 01/10	Task 1.3. Use-case diagrams, detailed use-case descriptions, related analysis.	1.0
Lê Quốc Bảo, Lưu Minh Tú	01/10 - 27/10	Task 2.1, 2.2. System modeling: activity and sequence diagrams for a specific module. Descriptions for each diagram.	2.0
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Mai Nam Phương, Lưu Minh Tú	27/10 - 17/11	Task 3.1, 3.2. Design layered architecture, and component diagram.	3.0
Lưu Bảo Long	17/11 - 24/11	Task 4.1, 4.2. Repository setup, document organization, and version control. Collaborative task for all members.	4.0
Mai Nam Phương, Lưu Minh Tú	17/11 - 24/11	Task 4.3. Usability testing for MVP 1, documentation of feedback, and report preparation. Collaborative task.	4.0
Mai Hoàng Phúc, Lưu Bảo Long	24/11 - 08/12	Task 5.1, 5.2. Develop MVP 2 and present the entire project. Prepare report and slide for presentation.	5.0

# 1 Requirement elicitation

## 1.1 Domain Context

The Student Smart Printing Service (HCMUT\\_SSPS) at Ho Chi Minh City University of Technology (HCMUT) is designed to offer a convenient, efficient, and controlled document printing solution for students across its campuses. The system is integrated with a network of printers located throughout the university, with each printer uniquely identified by ID, brand, model, a brief description, and precise location (campus, building, and room). Students can easily print their documents by uploading files to the system, selecting a printer, and customizing printing options such as paper size, page range, single- or double-sided printing, and number of copies. The permitted file types are regulated by the Student Printing Service Officer (SPSO). To ensure accountability, the system logs all printing actions, including details such as student ID, printer ID, and file name, printing times, and page counts. Both students and the SPSO can view printing logs and reports for specific time periods, with a summary of pages printed by size. Each semester, students receive a default quota of A4 pages, and additional pages can be purchased through the system using the university's BKPay online payment system. The system enforces that students cannot print more than their available balance, with A3 pages counting as two A4 pages. The SPSO has administrative control over printer management, including the ability to add, enable, or disable printers, as well as configure default page quotas, allowable file types, and system settings. Monthly and annual reports on printing usage are automatically generated and stored for administrative review. All users are authenticated through the HCMUT Single Sign-On (SSO) system, and the service is accessible through both a web-based and mobile app, ensuring ease of use and accessibility for students and staff alike.

### 1.1.1 Stakeholders and Needs

1. **Students:** As the primary users, students are central to the Student Smart Printing Service (HCMUT\\_SSPS). Their needs include a user-friendly interface that allows them to efficiently print documents through both a mobile app and web platform. Key features they rely on include the ability to locate active printers across campus, view detailed information such as printer ID, location, and availability, and customize print settings such as paper size, number of copies, and single- or double-sided printing. Additionally, students need seamless access to payment services that enable them to purchase additional printing pages when they exceed the default quota provided by the university each semester. A system that supports convenient payment integration (BKPay), is crucial for this purpose.

**2. Student Printing Service Officers (SPSO):**

SPSOs play a critical role in managing the printing system and ensuring smooth operations for students. They require robust administrative tools to regulate and control the service, including the ability to determine which file types are allowed for printing and configure system-wide settings, such as default printing quotas. Monitoring student printing activities is essential, as SPSOs need access to logs that track the usage history of individual students, printers, and overall system performance. Additionally, the system must generate automated periodic reports, providing insight into usage trends and allowing for performance reviews. SPSOs also need tools to manage printers directly, including the ability to add new printers to the network, enable or disable specific printers, and oversee maintenance requirements.

**3. Computer and Technology Center:**

This department is responsible for the technical infrastructure and maintenance of the HCMUT\_SSPPS system. Their primary concerns are ensuring the system's reliability, security, and accessibility for all users. The Computer and Technology Center is tasked with regular system updates, resolving any technical issues, and addressing any system failures or disruptions that may occur. They also work closely with the other stakeholders to ensure system compatibility with existing IT infrastructure, such as the HCMUT Single Sign-On (SSO) for authentication and integration with online payment platforms.

**4. Financial and Accounting Department:** This department is involved in managing the financial aspects of the printing service, particularly the online payment system that allows students to purchase additional printing pages beyond their free quota. The Financial and Accounting Department ensures the smooth functioning of the payment gateway (e.g., BKPay), verifying that all transactions are properly processed and recorded. They are also responsible for handling financial data input and reporting, ensuring that students are charged accurately for their additional printing needs. Additionally, they oversee the reconciliation of payments and manage any financial discrepancies that arise.

**5. Equipment and Facilities Management Office:**

This office is responsible for the procurement, installation, and maintenance of the printers used across campus. They collaborate closely with printer manufacturers and vendors to ensure that the printers are functioning optimally. Their role includes performing regular maintenance, troubleshooting hardware-related issues, and replacing faulty equipment when necessary. They also ensure that all printers are compatible with the HCMUT\_SSPPS

system and meet the required specifications for student use. This office plays a vital role in ensuring that the physical infrastructure of the printing system operates smoothly, complementing the software components managed by other stakeholders.

### **1.1.2 Benefits of the System**

The Student Smart Printing Service (HCMUT\_SSPPS) project brings significant advantages to both students and the broader university community. For students, the system enhances convenience by providing easy access to printers via a web platform or mobile application, allowing them to print documents quickly without hassle. They can tailor their printing preferences, such as selecting paper size, single- or double-sided printing, and other customizable options, enabling a more personalized and efficient printing experience. Additionally, the system provides a detailed overview of their printing history, helping students keep track of their usage, make informed decisions, and manage their printing budget effectively, with semester-specific page allocations set by the university.

From the perspective of the Student Printing Service Officers (SPSOs), the system simplifies the management of the entire printing environment. It allows them to monitor student activities, adjust system settings in line with university policies, and generate comprehensive logs and reports for more effective decision-making. Moreover, SPSOs can oversee financial transactions related to the purchase of additional printing pages, ensuring proper financial management and transparency.

In terms of the HCMUT\_SSO authentication service, the system integrates seamlessly as a third-party application, utilizing the university's login capabilities for student account management. It simplifies the authentication process for students, offering a user-friendly interface that eliminates the need for complex command-line logins, while providing an accessible environment for secure access.

Regarding the online payment system, it acts as a bridge between students' bank accounts and the university, streamlining the process of purchasing additional printing pages. This removes the need for students to visit physical payment offices, offering a more convenient, time-saving alternative. Similar to the authentication service, the system helps format payment data properly and provides an intuitive interface for completing financial transactions efficiently.

## **1.2 Functional and non-functional Requirements**

### **1.2.1 Functional Requirements**

#### **Stakeholder 1: Students**

1. The system shall allow students to upload document files of permitted types for printing.
2. Students can select a printer from lists of available printers around the campus.
3. The system shall allow students to specify printing properties, including paper size, number of pages, single- or double-sided printing, and number of copies.
4. The system shall prevent students from exceeding their allocated printing page balance, unless additional pages are purchased.
5. The system shall provide students with access to their personal printing history, including the number of printed pages per page size and printing logs for a specified time period.

#### **Stakeholder 2: Student Printing Service Officers (SPSOs)**

1. SPSOs are allowed to manage printers by adding, enabling, disabling, removing printers.
2. The system shall enable SPSOs to configure file types that are permitted for printing.
3. The system shall provide SPSOs access to view the printing history logs of all students or specific students for a given time period.
4. The system shall generate and store monthly and yearly reports on printing usage, which can be accessed by SPSOs at any time.
5. The system shall allow SPSOs to configure default page allocations for each student per semester and manage additional page purchases.

#### **Stakeholder 3: Computer and Technology Center (CTC)**

1. The system must allow the CTC to add, configure, enable, or disable printers in the network, ensuring that printers are correctly identified by ID, brand, model, and location for efficient management.
2. The CTC must be able to define and modify default printing quotas for students each semester, and control the types of files that are permitted for upload to maintain system efficiency and prevent compatibility issues.
3. The system must seamlessly integrate with the HCMUT Single Sign-On (SSO) system to ensure secure and centralized authentication for all users, including students, staff, and administrators.
4. The system must generate monthly and annual reports on printing usage, logging all activities and providing summaries by printer, file type, page size, and user for administrative review and auditing purposes.

5. The CTC must manage the integration with the BKPay online payment system, ensuring that students can purchase additional printing credits and enforcing the rule that students cannot exceed their available balance during print jobs.

#### **Stakeholder 4: Financial and Accounting Department**

1. The system shall allow students to make payments for additional printing pages via the university's online payment system (e.g., BKPay).
2. The system shall track all transactions related to page purchases made by students.
3. The system shall generate financial reports summarizing payments and printing-related transactions for the department.
4. The system shall prevent students from purchasing more printing pages than their account balance allows.
5. The system shall integrate with the university's financial systems to securely transfer funds from student accounts to the university's account.

#### **Stakeholder 5: Equipment and Facilities Management Office**

1. The system shall allow the facilities office to monitor the operational status of each printer, including errors and maintenance needs.
2. The system shall provide notifications for printer malfunctions or low supplies (ink, paper) to the maintenance team.
3. The system shall log all maintenance activities performed on each printer, including repair and supply refills.
4. The system shall allow the facilities office to update printer descriptions and specifications when new equipment is installed.
5. The system shall track printer usage statistics to assist in decision-making about printer replacement or relocation.

### **1.2.2 Non-Functional Requirements**

#### **1. Performance**

- The system shall process print job requests and display print status updates within 3 seconds to ensure a responsive user experience.
- The system shall be capable of handling up to 1,000 concurrent print requests without degradation in performance.

## **2. Scalability**

- The system shall support the addition of up to 200 new printers with minimal changes to the existing architecture.
- The system shall accommodate an increase in the number of users to 15,000 students, maintaining performance levels within acceptable limits.

## **3. Maintainability**

- The system shall provide comprehensive documentation, including user manuals and technical guides, to support maintenance and troubleshooting activities.
- The system shall employ modular design principles to facilitate straightforward updates and enhancements, minimizing disruptions to ongoing operations.

## **4. Data Integrity**

- The system shall enforce validation rules for all input data, including print job details and payment information, to prevent errors and ensure data accuracy.
- The system shall implement automatic data consistency checks and reconciliation processes to detect and correct discrepancies or anomalies in the data.

## **5. Accessibility**

- The system shall support localization and internationalization features to cater to users from different regions and language preferences.
- The system is designed to operate effectively across varying network conditions, ensuring that users with limited bandwidth can still access essential features and complete tasks.

## 1.3 Use-case Diagrams

### 1.3.1 Use-case Diagram for the Whole System

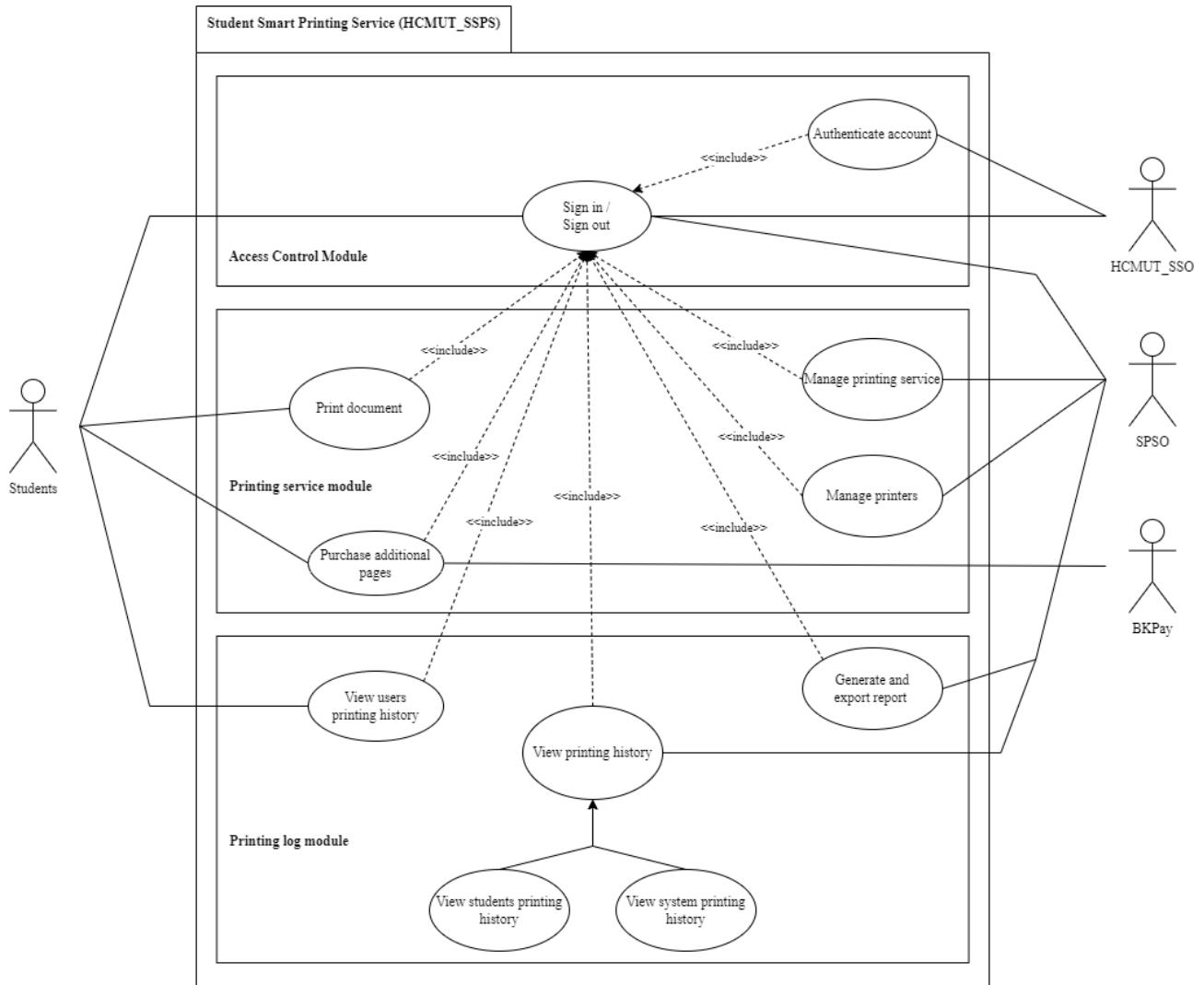


Figure 1.1: Use-case Diagram for the Whole System

### 1.3.2 Use-case Diagram for Printing Service Module

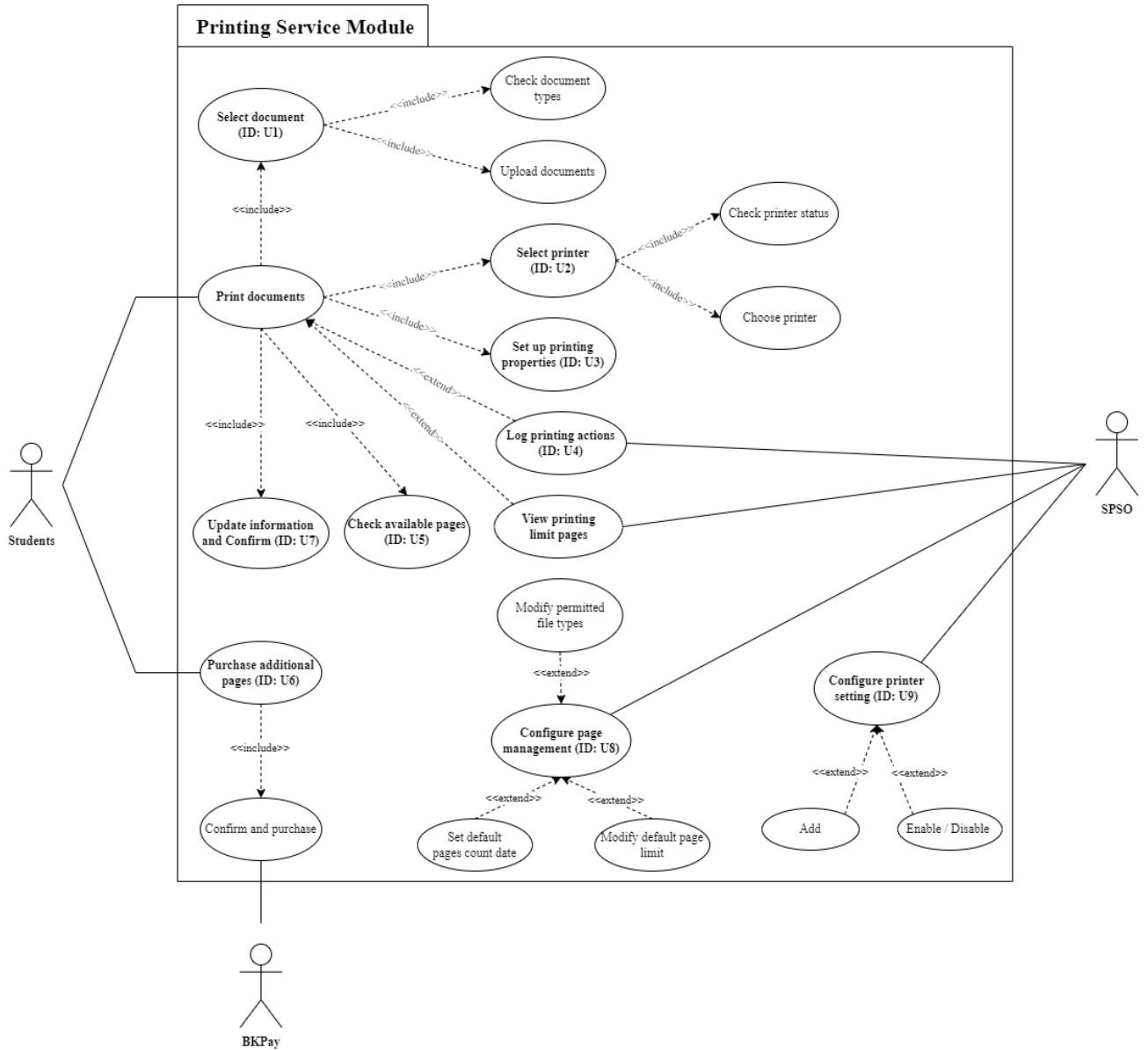


Figure 1.2: Use-case Diagram for Printing Service Module

### 1.3.3 Details of Use-cases in Printing Service Module

#### 1. Use-case Select Document

<b>Use-case ID</b>	<b>U1</b>
<b>Use-case Name</b>	Select Document
<b>Use-case overview</b>	Students are enabled to upload a document file for printing through the HCMUT_SSPPS system.
<b>Actors</b>	Students
<b>Trigger</b>	The student clicks on the "Select document" option in the navigation bar.
<b>Pre-conditions</b>	<ul style="list-style-type: none"><li>- The students have logged into the HCMUT_SSPPS system.</li><li>- The system and database are functional.</li><li>- Internet connectivity is available.</li></ul>
<b>Post-conditions</b>	The document files have been uploaded successfully.
<b>Normal flow</b>	<ol style="list-style-type: none"><li>1. The student clicks on the "Select document" option in the user interface.</li><li>2. The system displays a file upload interface, allowing the student to search, select, and approve the desired document file from their local device.</li><li>3. The system starts the upload process, showing the progress to the student.</li><li>4. Upon completion of the upload, the system provides confirmation of a successful upload.</li></ol>
<b>Alternative flow</b>	None.
<b>Exception flow</b>	If an unexpected system error (such as loss of connection) occurs during the upload process: <ul style="list-style-type: none"><li>- The system shows an error message to the student, explaining the problem.</li><li>- The student has the option to attempt the upload again.</li></ul>

## 2. Use-case Select Printer

<b>Use-case ID</b>	<b>U2</b>
<b>Use-case Name</b>	Printer Selection
<b>Use-case overview</b>	This use case enables a student to pick a printer from the available options within the HCMUT_SSPPS system.
<b>Actors</b>	Student
<b>Trigger</b>	The student selects the “Select printer” option in the user interface.
<b>Pre-conditions</b>	- The student is logged into the HCMUT_SSPPS system. - The system and database are operational. - Internet access is available.
<b>Post-conditions</b>	The student has successfully chosen a printer for their printing request.
<b>Normal flow</b>	1. The system shows a list of available printers, including their name and location. 2. The student examines the printer options and picks a preferred printer for their printing task. 3. The system acknowledges the printer choice and informs the student that the selection has been successfully made.
<b>Alternative flow</b>	None
<b>Exception flow</b>	In case of an unexpected system error (such as loss of connection) during the printer selection process: The system shows an error message to the student, detailing the problem. The student has the option to attempt the process again.

### 3. Use-case Set up Printing Properties

<b>Use-case ID</b>	U3
<b>Use-case Name</b>	Printing Properties Selection
<b>Use-case overview</b>	This use case permits a student to choose printing settings for their document within the HCMUT_SSPPS system.
<b>Actors</b>	Student
<b>Trigger</b>	The student selects print settings option for the paper in the user interface.
<b>Pre-conditions</b>	<ul style="list-style-type: none"> <li>- The student is authenticated and logged into the HCMUT_SSPPS system.</li> <li>- The system and database are operational.</li> <li>- Internet access is available.</li> </ul>
<b>Post-conditions</b>	The student has successfully chosen the desired print settings for their document.
<b>Normal flow</b>	<ol style="list-style-type: none"> <li>1. The system presents the available print setting options, including:           <ul style="list-style-type: none"> <li>- Paper size (such as A4, A3, letter, etc.).</li> <li>- Number of pages (of the file) to be printed.</li> <li>- Single-sided or double-sided printing.</li> <li>- Number of copies to be printed.</li> </ul> </li> <li>2. The student selects from the available print setting options.</li> <li>3. The system acknowledges the chosen print settings.</li> </ol>
<b>Alternative flow</b>	None.
<b>Exception flow</b>	<ul style="list-style-type: none"> <li>- If an unexpected system error (such as loss of connection) occurs during the print settings selection process: The system presents an error message to the student, detailing the problem. The student is then given the opportunity to retry the process.</li> <li>- In case the user enters incorrect information, display an error message and prompt the user to enter it again.</li> </ul>

## 4. Use-case Log Printing Actions

<b>Use-case ID</b>	U4
<b>Use-case Name</b>	Log Printing Actions
<b>Use-case overview</b>	This use case enables the Student Printing Service Officer (SPSO) to maintain a structured database of printing requests within the HCMUT_SSPPS system.
<b>Actors</b>	SPSO
<b>Trigger</b>	Students confirm their printing requests.
<b>Pre-conditions</b>	<ul style="list-style-type: none"> <li>- The student is logged into the HCMUT_SSPPS system.</li> <li>- The student and SPSP has checked and confirmed the print settings.</li> <li>- The system and database are operational.</li> <li>- Internet access is available.</li> <li>- The chosen printer is operational.</li> </ul>
<b>Post-conditions</b>	The printing action is completed, and the SPSO has detailed records of the printing request, including student ID, printer ID, file name, printing start and end times, and number of pages per size.
<b>Normal flow</b>	<ol style="list-style-type: none"> <li>1. After the student confirms the print settings, the information is sent to the designated printer.</li> <li>2. The printer completes the printing task, recording the time taken.</li> <li>3. The system gathers action data from both the student and the printer.</li> <li>4. The system consolidates this information and updates the database.</li> </ol>
<b>Alternative flow</b>	None.
<b>Exception flow</b>	If the printer encounters issues such as printing errors or timing log discrepancies, the data integration may be compromised, requiring the SPSO to manually verify and upload the correct data into the system.

## 5. Use-case Check Available Pages

<b>Use-case ID</b>	U5
<b>Use-case Name</b>	Check Available Pages
<b>Use-case overview</b>	This use case allows a student to check the number of available pages for printing in their account within the HCMUT_SSPPS system.
<b>Actors</b>	Student
<b>Trigger</b>	Student chooses the "Check Available Pages" in the user interface.
<b>Pre-conditions</b>	<ul style="list-style-type: none"> <li>- The student has logged into the HCMUT_SSPPS system.</li> <li>- The student has selected printing properties.</li> <li>- The system and database are available.</li> <li>- The internet is available.</li> </ul>
<b>Post-conditions</b>	The student is presented with the number of available pages for printing in their account.
<b>Normal flow</b>	<ol style="list-style-type: none"> <li>1. The student selects "Check Available Pages" option in the user interface.</li> <li>2. The system retrieves the student's account information and displays the current number of available pages for printing.</li> <li>3. The system presents the available page information to the student, specifying the number of A4-size pages remaining for the current semester.</li> </ol>
<b>Alternative flow</b>	None.
<b>Exception flow</b>	<p>If there is an unexpected system error (such as loss of connection) during the checking available pages process:</p> <ul style="list-style-type: none"> <li>- The system displays an error message to the student, indicating the issue.</li> <li>- The student can retry the process.</li> </ul>

## 6. Use-case Purchase Additional Pages

<b>Use-case ID</b>	<b>U6</b>
<b>Use-case Name</b>	Purchase Additional Pages
<b>Use-case overview</b>	Students can buy extra print pages for use within the HCMUT_SSPPS system when their demand is insufficient.
<b>Actors</b>	Student, BKPay
<b>Trigger</b>	The student selects the “Purchase Additional Pages” option in the user interface.
<b>Pre-conditions</b>	<ul style="list-style-type: none"> <li>- The student is logged into the HCMUT_SSPPS system.</li> <li>- The student has reviewed their available print credits and determined a need for more.</li> <li>- The system and database are operational.</li> <li>- Internet connectivity is ensured.</li> </ul>
<b>Post-conditions</b>	Student successfully purchases additional print credits, and new balance is updated in their account.
<b>Normal flow</b>	<ol style="list-style-type: none"> <li>1. The student clicks on the “Purchase Additional Pages” option in the user interface.</li> <li>2. The student selects the desired print pages package from the system display screen.</li> <li>3. Students confirm the purchase by clicking on the Purchase button, which initiates the payment process through an integrated payment gateway.</li> <li>4. Students are redirected to the BKPay interface to complete the payment.</li> <li>5. Upon successful payment verification, the system updates the student’s account with the newly purchased print credits.</li> <li>6. The system confirms the successful transaction to the student, displaying the updated credit balance.</li> </ol>
<b>Alternative flow</b>	If the student chooses not to proceed with the purchase: <ul style="list-style-type: none"> <li>- The student can cancel the transaction at any point before final confirmation, and the system will revert to the previous state without any changes.</li> </ul>
<b>Exception flow</b>	If there is a failure in processing or verifying the payment: <ul style="list-style-type: none"> <li>- The system presents an error message to the student, detailing the problem.</li> <li>- Students can attempt the process again.</li> </ul>

## 7. Use-case Update Information and Confirm

<b>Use-case ID</b>	<b>U7</b>
<b>Use-case Name</b>	Update Information and Confirm
<b>Use-case overview</b>	This use case enables a student to print a document file using the HCMUT_SSPS system.
<b>Actors</b>	Students
<b>Trigger</b>	The student selects the "Print" option in the user interface.
<b>Pre-conditions</b>	<ul style="list-style-type: none"> <li>- The student is logged into the HCMUT_SSPS system.</li> <li>- The student has configured the printing settings and has sufficient pages available for printing.</li> <li>- The system and database are operational.</li> <li>- A stable internet connection is available.</li> </ul>
<b>Post-conditions</b>	The document is printed successfully on the chosen printer.
<b>Normal flow</b>	<ol style="list-style-type: none"> <li>1. The student confirms the printing request.</li> <li>2. The system processes the request by verifying the configuration, sending the document file to the selected printer, and initiating the printing job.</li> <li>3. The system deducts the corresponding number of pages from the student's account balance.</li> <li>4. The system logs the printing activity, recording details such as student ID, printer ID, file name, printing start time, and the number of pages for each page size.</li> <li>5. The system informs the student that the print job has been successfully submitted and is in progress.</li> <li>6. The printer receives the print request, processes the document file, and prints the document according to the specified settings.</li> <li>7. The printed document is placed in the printer's output tray.</li> <li>8. The student retrieves the printed document from the output tray.</li> </ol>
<b>Alternative flow</b>	<p>If the configuration is invalid:</p> <ul style="list-style-type: none"> <li>- A message will be displayed, prompting the user to adjust their settings to meet the system's requirements.</li> </ul>
<b>Exception flow</b>	<p>If a technical error occurs during the printing process:</p> <ul style="list-style-type: none"> <li>- The system will display an error message to the student, explaining the issue.</li> <li>- The student will have the option to retry the printing process.</li> </ul>

## 8. Use-case Configure Page Management

<b>Use-case ID</b>	<b>U8</b>
<b>Use-case Name</b>	Configure Page Management
<b>Use-case overview</b>	This use case enables the SPSO to configure the page management settings within the HC-MUT_SSPPS system.
<b>Actors</b>	SPSO
<b>Trigger</b>	The SPSO clicks on the "Page Management Setting" button on the user interface.
<b>Pre-conditions</b>	<ul style="list-style-type: none"> <li>- The SPSO is logged into the HCMUT_SSPPS system.</li> <li>- The system and database are operational.</li> <li>- A stable internet connection is available.</li> </ul>
<b>Post-conditions</b>	The page management settings are successfully configured and updated within the system.
<b>Normal flow</b>	<ol style="list-style-type: none"> <li>1. The SPSO selects the "Page Management Settings" option in the user interface.</li> <li>2. The system displays the current page management settings, including options to change the default number of pages, the dates for distributing the default number of pages to all students, the accepted file types, and other relevant configurations.</li> <li>3. If the SPSO wishes to update any settings, the system provides editable fields or options next to each relevant attribute.</li> <li>4. The system confirms the updated page management settings.</li> <li>5. The system applies the updated page management settings to all relevant processes and functionalities within the HCMUT_SSPPS system.</li> </ol>
<b>Alternative flow</b>	If the SPSO chooses not to make any changes: <ul style="list-style-type: none"> <li>- They can exit the page management configuration section without saving any updates, and the system will keep the current page management settings intact.</li> </ul>
<b>Exception flow</b>	If an unexpected system error occurs (such as a lost connection) during the configuration process: <ul style="list-style-type: none"> <li>- The system displays an error message to the SPSO, detailing the issue.</li> <li>- The SPSO will then have the option to retry the configuration process.</li> </ul>

## 9. Use-case Configure Printer Setting

<b>Use-case ID</b>	<b>U9</b>
<b>Use-case Name</b>	Configure Printer Settings
<b>Use-case overview</b>	This use case enables the SPSO to configure the printer settings within the HCMUT_SSPPS system.
<b>Actors</b>	SPSO
<b>Trigger</b>	The SPSO selects the “Configure Printer Settings” option in the user interface.
<b>Pre-conditions</b>	<ul style="list-style-type: none"> <li>- The SPSO is logged into the HCMUT_SSPPS system.</li> <li>- The system and database are operational.</li> <li>- Internet connectivity is available.</li> </ul>
<b>Post-conditions</b>	The printer settings are successfully configured and updated in the system.
<b>Normal flow</b>	<ol style="list-style-type: none"> <li>1. The SPSO selects the “Configure Printer Settings” option in the user interface.</li> <li>2. The system displays the current printer settings, including a list of available printers and other relevant configurations.</li> <li>3. The SPSO makes the necessary changes to the printer settings, such as adding, enabling, or disabling printers.</li> <li>4. The system confirms the updated printer settings.</li> <li>5. The system applies the updated printer settings to all relevant processes and functionalities within the HCMUT_SSPPS system.</li> </ol>
<b>Alternative flow</b>	<ul style="list-style-type: none"> <li>- If the SPSO chooses not to make any changes, they can exit the printer settings configuration section without saving any updates, and the system will keep the current printer settings.</li> <li>- The SPSO can enable or disable all printers by selecting the “Enable All Printers” or “Disable All Printers” button.</li> </ul>
<b>Exception flow</b>	<p>If an unexpected system error occurs (such as a lost connection) during the configuration process:</p> <ul style="list-style-type: none"> <li>- The system displays an error message to the SPSO, detailing the issue.</li> <li>- The SPSO will then have the option to retry the configuration process.</li> </ul>

## 2 System Modelling

### 2.1 Activity Diagram

#### 2.1.1 Activity Diagram for Printing Service Module

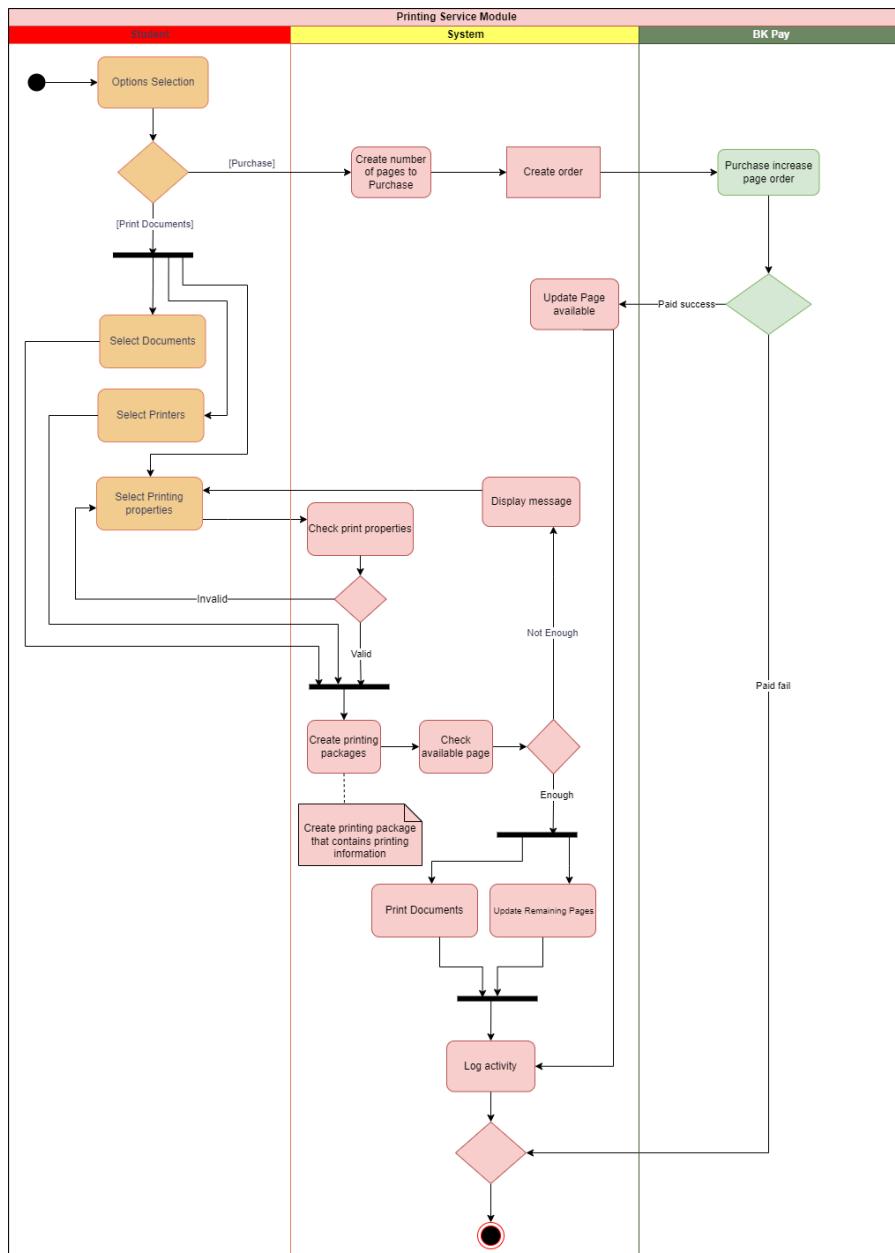


Figure 2.1: Activity Diagram for Printing Service Module

**Description:** The diagram indicates the interaction between the student and the printing service module.

**Key Elements:** Three swimlanes are provided in this case, including:

- **Student:** Initiating actions, such as choosing options (print documents or purchasing additional pages), and configuring print settings.
- **Printing Service Module (System):** Manages the print operations, verifies print settings, checks page availability, and handles printing and logging activities.
- **BKPay:** Handles purchase progress whenever a student sends a purchase request for additional pages.

#### **Activity Flow:**

- **Initial Choice:** The flow begins with an option from the student: either purchasing additional pages or creating a printing request.
- If the student decides to purchase, the flow redirects to the purchasing page, where after finishing the order creation process, a request will be sent to BKPay.

#### **Page Purchasing:**

- Here, students can adjust the amount of pages they want to buy for additional printing. After confirming their order, a request will be generated and sent to BKPay, then proceed to the purchasing process on the BKPay website.

**Printing Request Generation:** When student chooses to print a document, they proceed:

- **Select Document:** Select a valid file, whose extension is acceptable, to print.
- **Select Printer:** Select a printer compatible for the student to receive the document.
- **Configure Print Settings:** Change the printing settings to be compatible with system settings and the student's needs.

#### **Printing Request Validation:**

- The Printing Service Module checks the validity of print settings (printing properties, pages used for printing).
- If the print settings are invalid, the system will highlight the invalid settings and do nothing. If the settings are valid but the remaining pages are insufficient to print, the system will return and prompt the student to buy additional pages.

## Print and Log:

- After the validation is checked, a print request is sent to the corresponding printer, and the remaining pages are updated in parallel. After finishing all the required processes, the activity is logged.
- The process concludes with a finish state.

### 2.1.2 Activity Diagram for SPSO

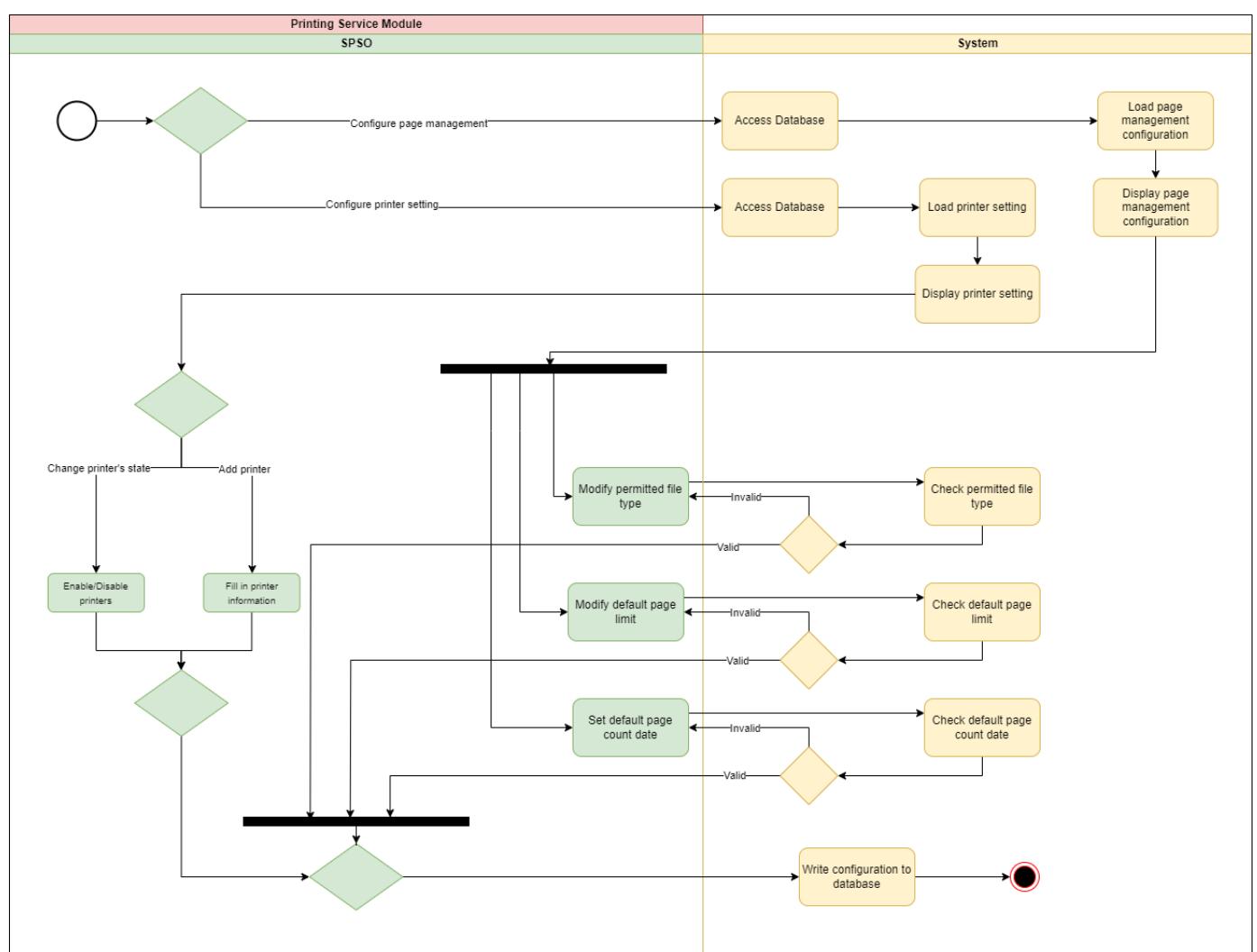


Figure 2.2: Activity Diagram for SPSO

**Description:** The diagram indicates the printer configuration workflow within the Printing Service Module. Only two swimlanes of the diagram are included: SPSO and System.

## **Workflow:**

- **Initial Choice:** As SPSO logs in, the SPSO has the option to choose whether to configure the printer settings or the page settings. Both choices require the system to access the database to retrieve needed information, load them, and display available options in a menu for SPSO to modify.

## **Modifying Configuration Settings:**

Three main settings can be modified:

- **Permitted File Type:** The system checks whether the type of the selected file is valid. If invalid, it returns an error; otherwise, it continues.
- **Default Page Limit:** The system checks if the number of pages is valid before applying changes.
- **Default Page Count Date:** The system checks if the effective date is valid; if invalid, it returns an error; otherwise, it continues.

## **Printer Configurations:**

- If SPSO decides to add an available printer, the "Add Printer" task is performed. Filling in the information of the corresponding printer is required before adding it to the list.
- In the "Printer List," SPSO can enable or disable printers whenever necessary. If there is no printer available for printing, the printing service is temporarily unavailable.

**Validation Check:** For every change, a validation check is performed to ensure that the new value is correct. Invalid changes are marked, and an error is returned to SPSO.

**Writing Configuration into Database:** Once all configurations are validated, the system writes updated values into the database. The workflow ends successfully if all changes are valid and stored.

## 2.2 Sequence Diagram

### 2.2.1 Diagram

Student Diagram:

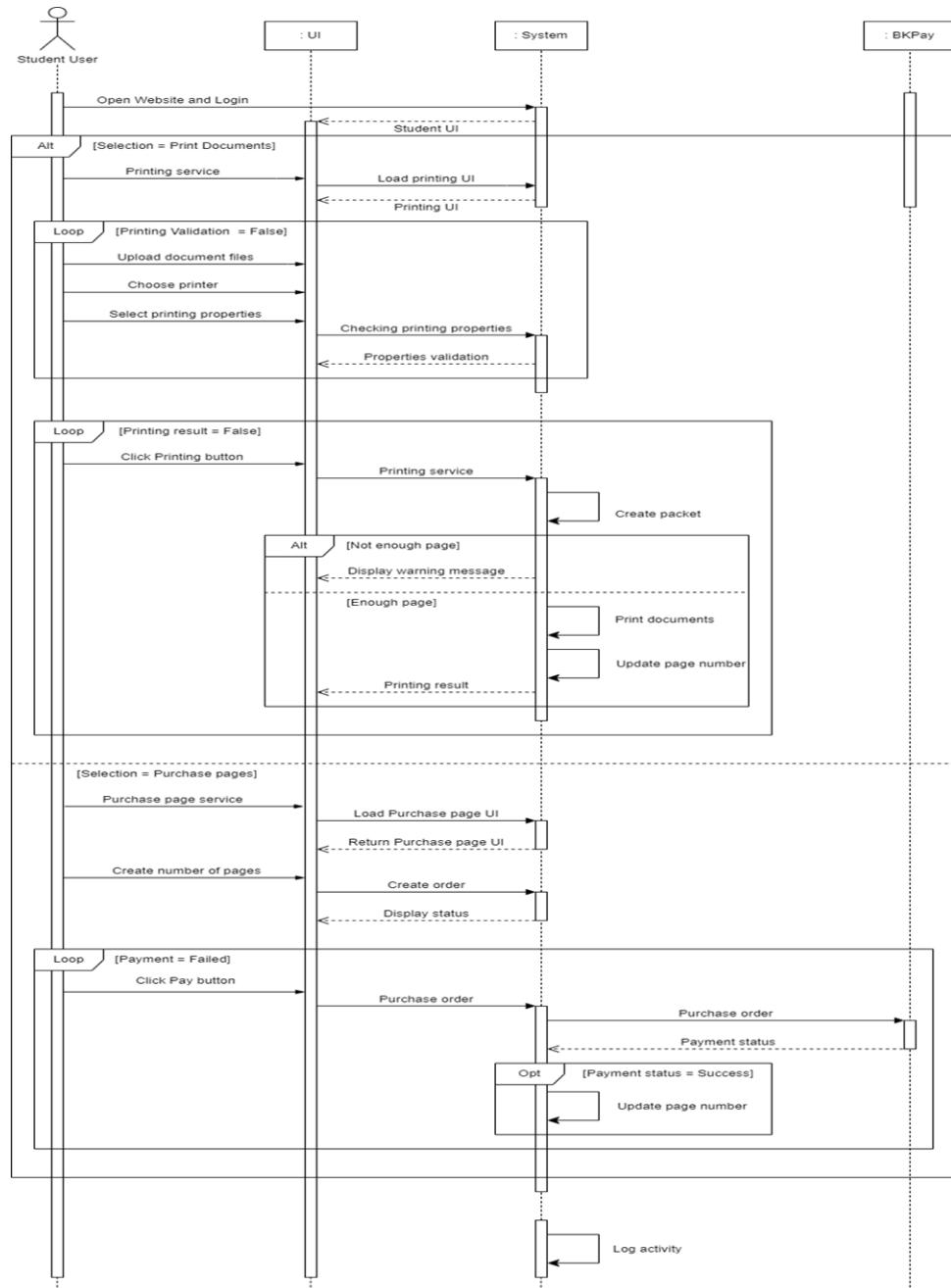


Figure 2.3: Student Diagram

For further investigation please [click here](#).

**Description:** This Student sequence diagram illustrates the interaction between a Student User, UI, System, and BKPay for printing documents and purchasing pages.

**Key Components:**

1. Student User
2. UI (User Interface)
3. System
4. BKPay (Payment System)

**Main Flow:**

**1. Login and Initial UI:**

- Student opens the website and logs in.
- System loads and displays the Student UI.

**2. Printing Service:**

- Student selects "Print Documents."
- System loads the printing UI.
- Student goes through a loop of actions until printing validation is successful:
  - (a) Upload document files.
  - (b) Choose printer.
  - (c) Select printing properties.
  - (d) System validates properties.

**3. Printing Process:**

- Student clicks the Printing button.
- System creates a packet including student printing information and properties.
- If there are not enough pages: System displays a warning message.
- If there are enough pages:
  - (a) System prints the documents.
  - (b) System updates the page number.
  - (c) System returns the printing result.

**4. Page Purchase:**

- If the student selects "Purchase Pages":
  - (a) System loads the Purchase Page UI.
  - (b) Student creates the number of pages to purchase.
  - (c) System creates an order and displays the status.

**5. Payment Process:**

- Student goes through a payment loop until successful:
  - (a) Clicks Pay button.
  - (b) System sends the purchase order to BKPay.
  - (c) BKPay returns the payment status.
- If payment is successful: System updates the page number.

**6. Finalization:**

- System logs the activity.

## SPSO Diagram

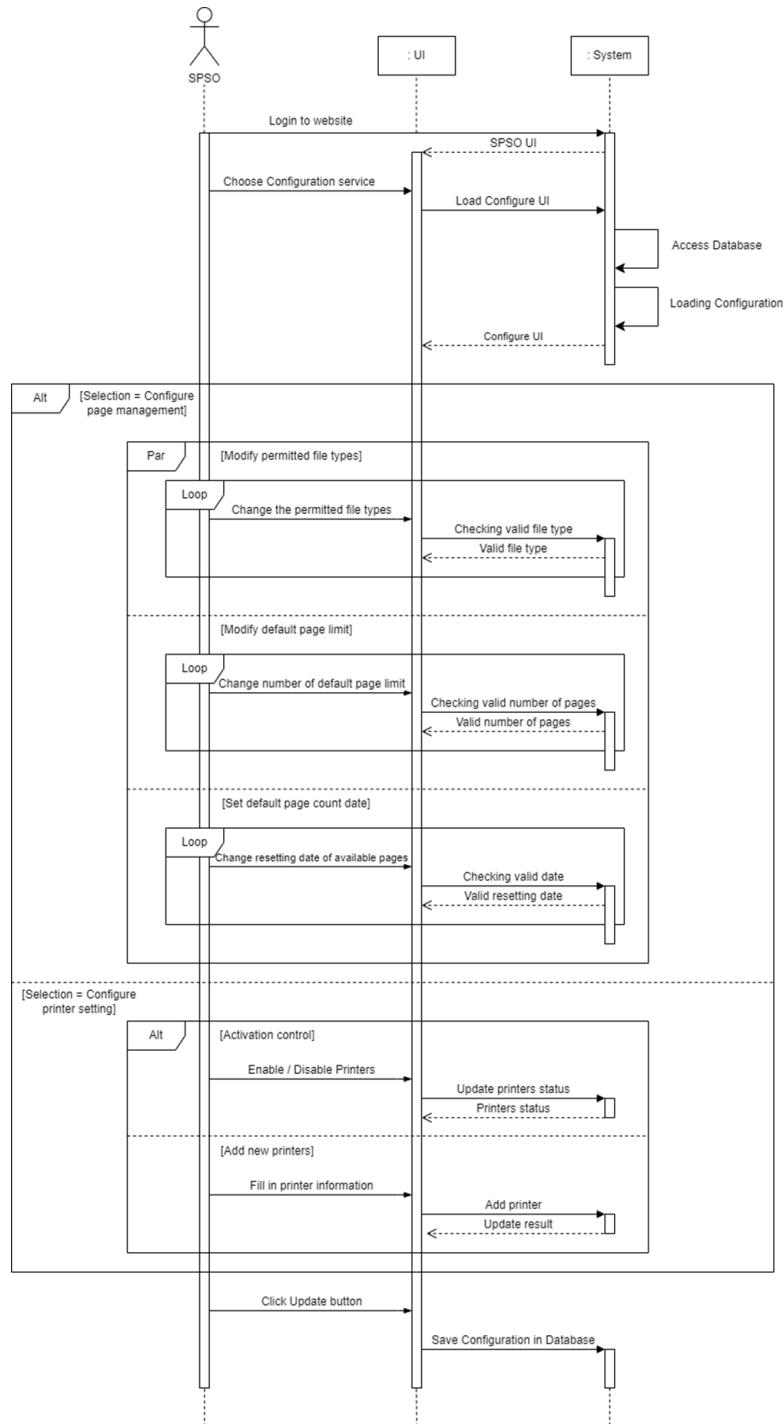


Figure 2.4: SPSO Diagram

SPSO Diagram: further investigation please [click here](#).

**Description:** This SPSO sequence diagram shows the interaction between an SPSO (presumably a system administrator), UI, and System for configuring various settings.

**Key Components:**

1. SPSO (System Administrator)
2. UI (User Interface)
3. System

**Main Flow:**

**1. Login and Initial UI:**

- SPSO logs into the website.
- System loads and displays the SPSO UI.

**2. Configuration Service:**

- SPSO chooses Configuration Service.
- System loads the Configure UI.
- System accesses the database and loads configuration.

**3. Page Management Configuration:**

- If SPSO selects "Configure Page Management":
  - (a) Modify permitted file types:
    - SPSO changes permitted file types.
    - System checks and validates file types.
  - (b) Modify default page limit:
    - SPSO changes the default page limit.
    - System checks and validates the number of pages.
  - (c) Set default page count date:
    - SPSO changes the resetting date of available pages.
    - System checks and validates the resetting date.

#### 4. Printer Configuration:

- If SPSO selects "Configure Printer Setting":
  - (a) Activation control:
    - SPSO enables/disables printers.
    - System updates and returns printer status.
  - (b) Add new printers:
    - SPSO fills in printer information.
    - System adds the printer and updates the result.

#### 5. Finalization:

- SPSO clicks the Update button.
- System saves the configuration in the database.

### 2.3 Class Diagram

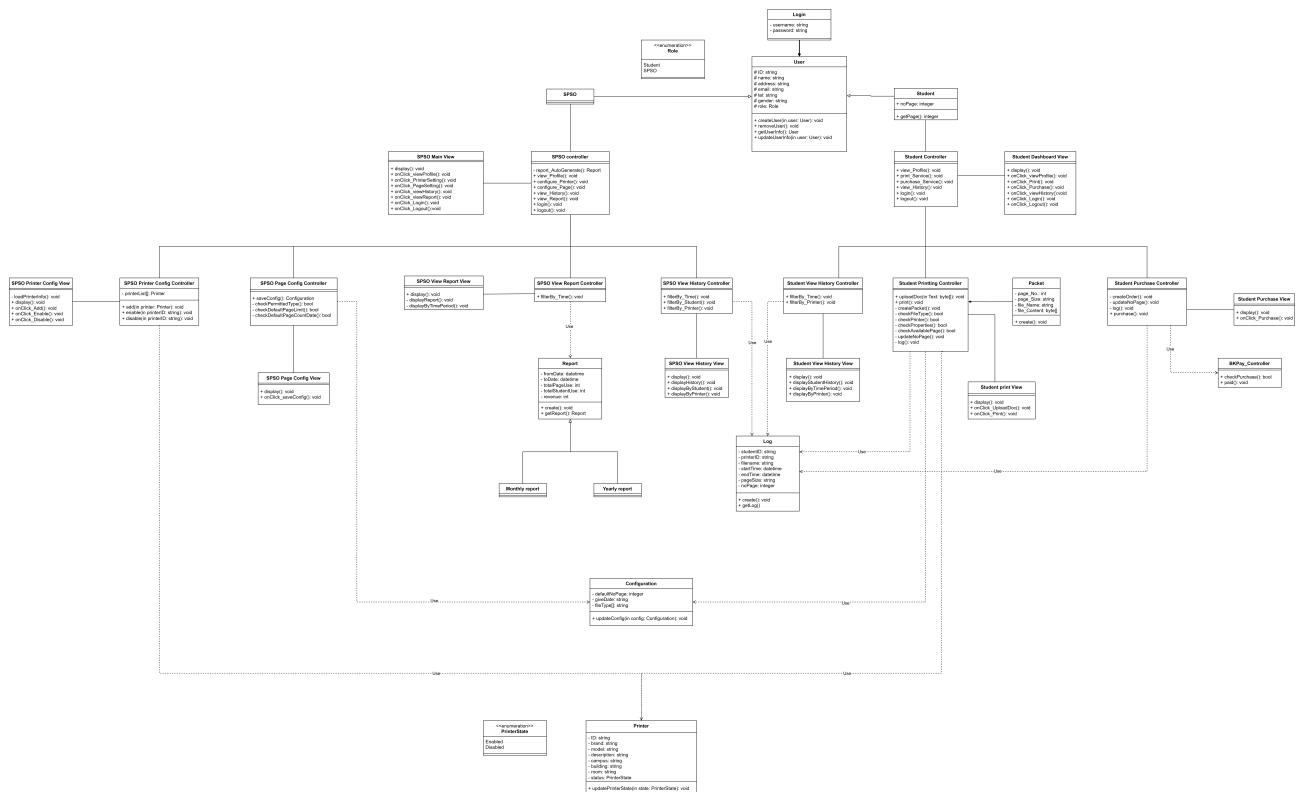


Figure 2.5: Class Diagram

## 2.4 Figma

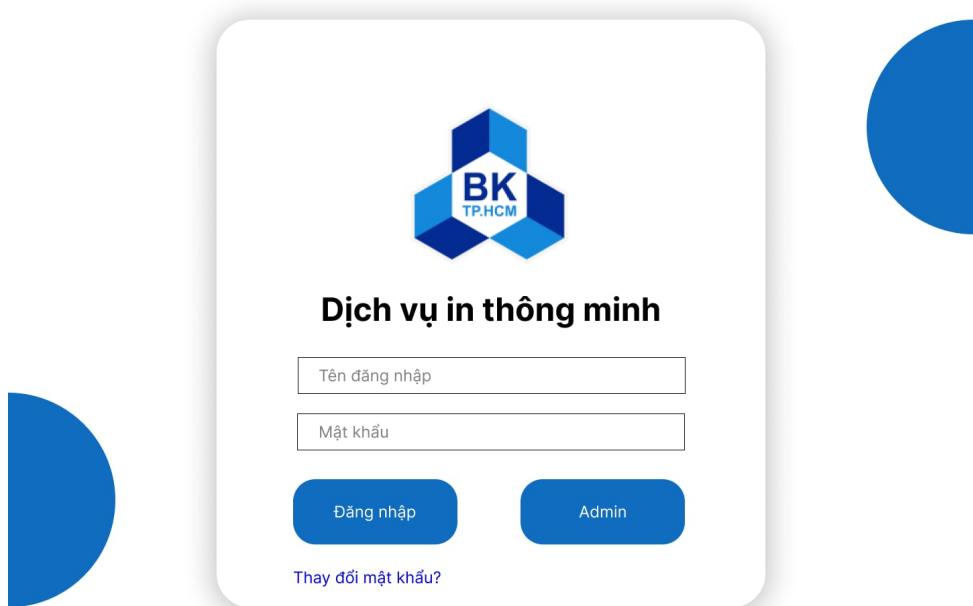


Figure 2.6: Login Page. Login page for both SPSO and students.

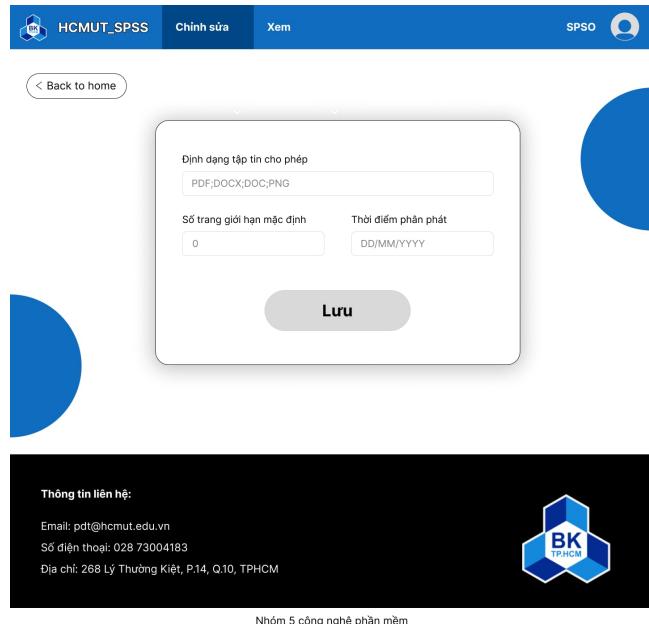


Figure 2.7: SPSO configure page management page.



## Chỉnh sửa

### Thông tin máy in



Chỉnh sửa thông tin các máy in hoặc thêm máy in mới.

### Tùy chọn in



Chỉnh sửa các cài đặt mặc định như số trang cung cấp, thời gian cung cấp và định dạng tập tin cho phép.

## Xem

### Lịch sử in



Xem lại toàn bộ các lần in đã được thực hiện bởi sinh viên tại trường.

### Báo cáo



Xem thống kê hàng tháng, hàng năm được tạo tự động bởi hệ thống.

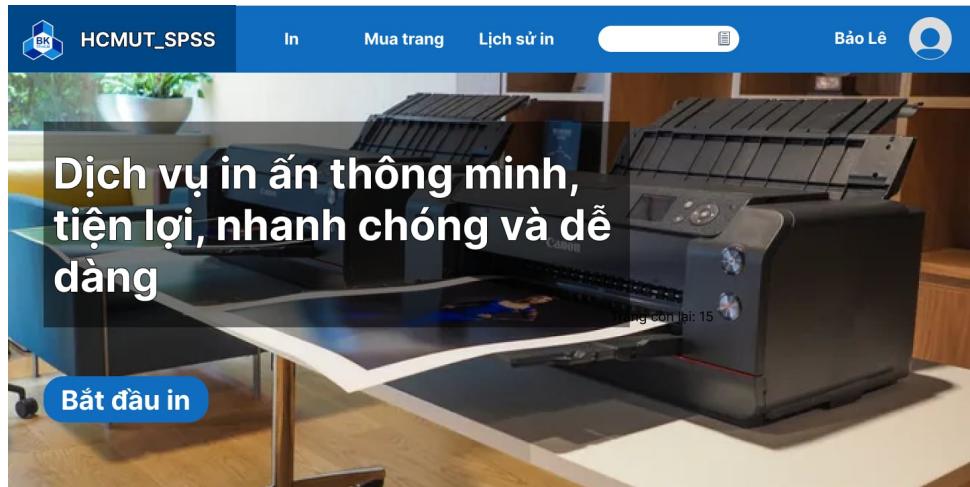
#### Thông tin liên hệ:

Email: pdt@hcmut.edu.vn

Số điện thoại: 028 73004183

Địa chỉ: 268 Lý Thường Kiệt, P.14, Q.10, TPHCM





<b>In</b>  Bắt đầu in tài liệu của bạn ngay!	<b>Mua trang</b>  Mua thêm trang với giá rẻ phù hợp với nhu cầu.	<b>Lịch sử in</b>  Xem lại những lần in trước đó của bản thân.
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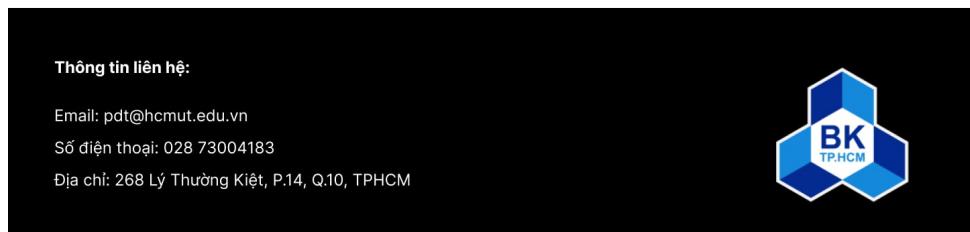


Figure 2.9: Student homepage.

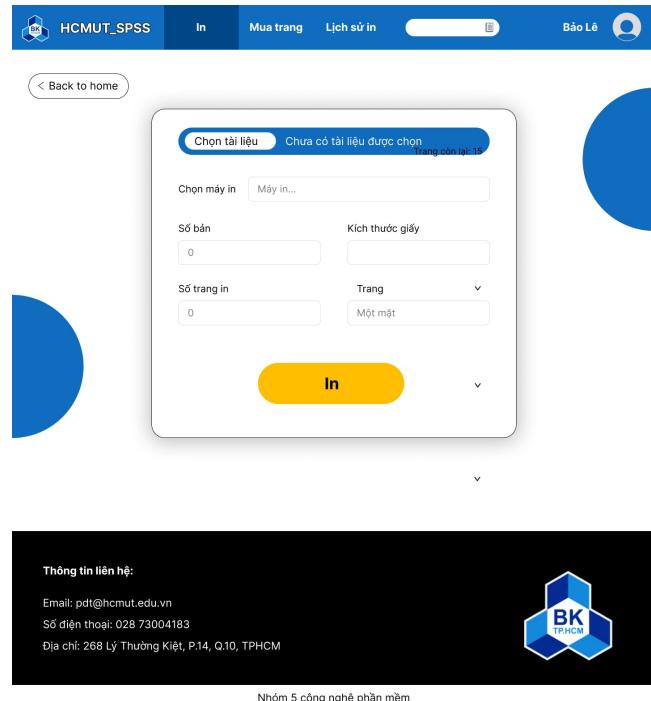


Figure 2.10: Printing service page.

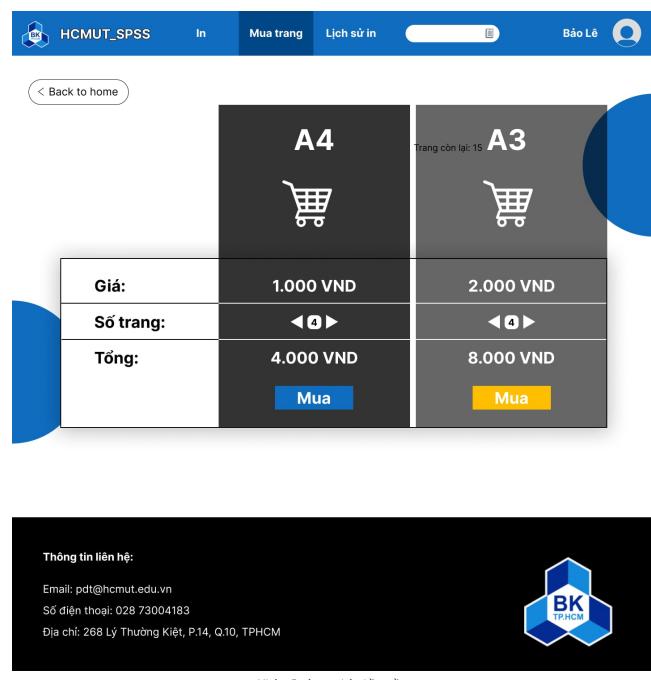


Figure 2.11: Purchase Page.

Figma Prototype link for interacting and details

### 3 Layered Architecture

#### 3.1 Architecture Design

##### 3.1.1 Presentation Strategy

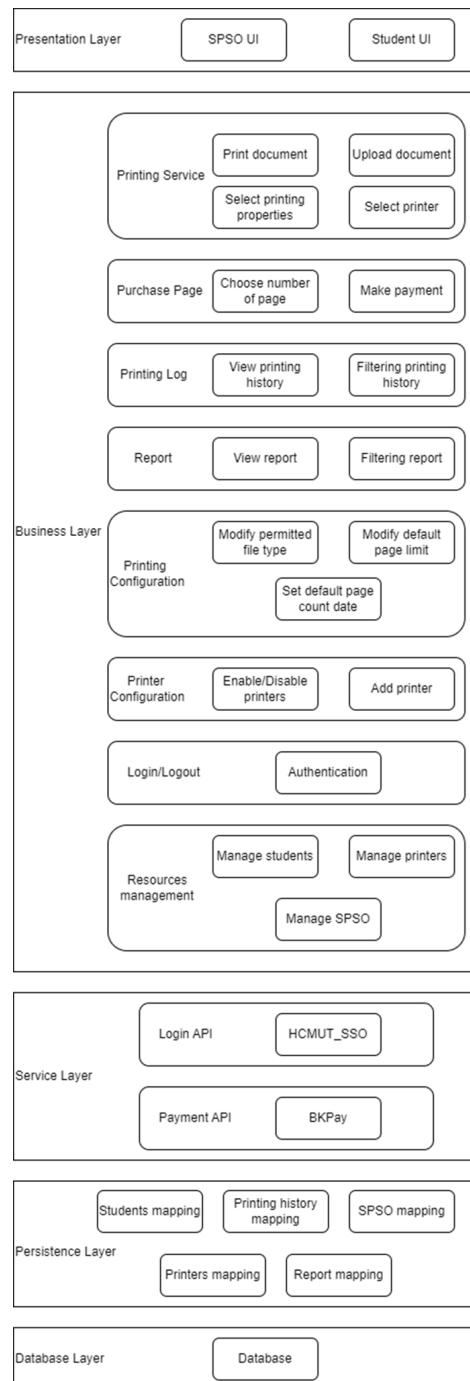


Figure 3.1: Layered Architecture Pattern

Our design approach prioritizes a color scheme that is dark and mild to minimize eye strain, especially considering that the majority of users are HCMUT students who spend significant time studying on digital devices. We have chosen a primary color of dark blue, blended with subtle purple, gray, and white highlights for key elements, creating a cohesive look with the HCMUT main theme, which is blue. Each action option will be displayed in clearly defined boxes, and printing history will be organized in rows to represent distinct printing events.

The website's layout will be simple and intuitive, with only four main pages, each serving a distinct purpose:

1. **Home page** for newly logged-in users.
2. **Printing Service page** for printing paper selection.
3. **Paper Purchase page** for purchasing additional pages.
4. **Printing History page** for reviewing printing history.

### 3.1.2 Data Storage Approach

Our printing service system will require storage for three main types of information:

- **Printers:** Includes details such as printer ID, brand/manufacturer, model, short description, and location (campus, building, room).
- **Students:** Stores information such as student ID, page balance, and associated actions.
- **Logging of printing actions:** Records each printing event to allow tracking and history retrieval.

These data types can be organized into tables with rows representing individual entries and columns for each attribute. For example, the **Printers** table would contain one row per printer and columns for each of the listed attributes. This structured, relational format allows for efficient logging and data retrieval. We plan to utilize MySQL as the database management system and connect it to the back-end using PHP.

### 3.1.3 API Management

To facilitate student paper payments, we plan to utilize open API services provided by OCB Bank, similar to the BKPAY system. HCMUT students, who are also SPSO users, typically hold an OCB account, which streamlines transactions.

- Payment Integration:** For efficient processing of paper payments, we will employ the OCB Bank API, selecting service packages suitable for the expected transaction volumes.
- Authentication:** We will use HCMUT SSO, a security protocol provided by HCMUT, for authentication across all services (e.g., myBK, BKel, etc.). This will require coordination with HCMUT to gain permission and integrate SSO access into our code.
- Printer Connection:** To connect with HCMUT printers, one server will manage requests, process information, and communicate with printers within the campus. We will develop back-end code to ensure seamless communication and printing operations.

This layered architecture supports scalability, maintainability, and user-friendly design while aligning with HCMUT's infrastructure and security protocols.

### 3.2 Component Diagram

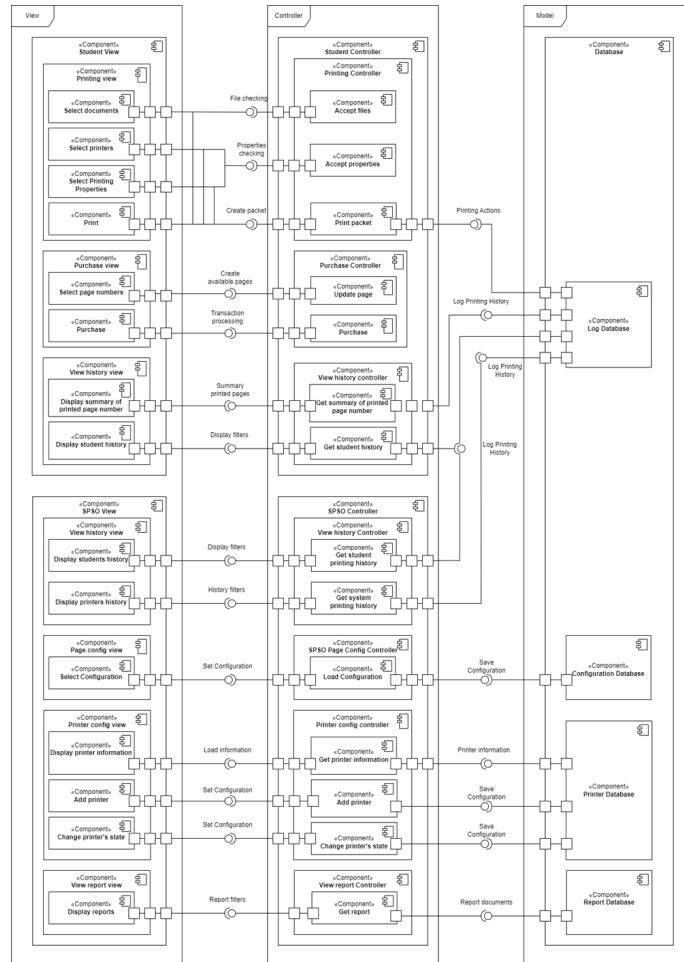


Figure 3.2: Component Diagram - Whole System

### 3.2.1 Description

The component diagram for the entire Printing Service system presents a modular design, divided into three layers: View, Controller, and Model. Each layer encapsulates specific functionalities to ensure a clean separation of concerns, enhancing scalability and maintainability.

- **View Layer:** The View Layer provides interfaces for users, allowing interactions with the system through various components designed for students and the Student Printing Service Office (SPSO).

- **Student View Components:**

- \* **Select Documents:** Allows students upload and select documents for printing.
    - \* **Select Printers:** Enables students to choose a specific printer for their job.
    - \* **Select Printing Properties:** Allows configuration of printing properties like paper size, color, and orientation.
    - \* **Purchase View:** Lets students choose the number of pages and make payments for printing.
    - \* **View History:** Displays the student's printing history and offers a summary of printed pages.

- **SPSO View Components:**

- \* **View History:** Allows SPSO personnel to access and filter the printing history for both students and printers.
    - \* **Page Config View:** Provides options to adjust default page configurations.
    - \* **Printer Config View:** Enables SPSO staff to add printers, display printer information, and change printer statuses.
    - \* **View Report:** Allows viewing of generated reports on printing activities within the system.

- **Controller Layer:** The Controller Layer serves as the mediator between the View and Model layers, processing requests and applying business logic.

- **Student Controller Components:**

- \* **Accept Files:** Validates uploaded files for printing.
    - \* **Accept Properties:** Checks if the selected printing properties are allowed.
    - \* **Print Packet:** Compiles print jobs into packets for processing.
    - \* **View History Controller:** Get student's printing history, page summaries.

- **Purchase Controller Components:**

- \* **Update Page:** Manages the page count for students based on purchases.
- \* **Purchase:** Processes payment transactions and updates page balances.

- **SPSO Controller Components:**

- \* **History Retrieval:** Manages access to detailed printing histories for students and printers.
- \* **Page Config Controller:** Loads and updates default page configurations as per SPSO preferences.
- \* **Printer Config Controller:** Adds new printers, updates printer details, and manages printer states.
- \* **View Report Controller:** Manages report generation, providing SPSO with summaries of system usage and statistics.

- **Model Layer:** The Model Layer manages the system's data and provides persistent storage for all components.

- **Database:** Centralized storage for student and printer information, configurations, and printing transactions.
- **Log Database:** Stores logs of all printing actions to ensure tracking and auditing capabilities.
- **Configuration Database:** Holds settings for default configurations for page limits, permitted file types, and other system preferences.
- **Printer Database:** Contains specific information about printers, including location, status, and specifications.
- **Report Database:** Stores data used for generating system usage reports, assisting SPSO in tracking printing activities and usage patterns.

This layered structure allows for a systematic flow of data and commands across the system. The **View Layer** interfaces with users, capturing inputs that the **Controller Layer** then processes, applying necessary business logic before interacting with the **Model Layer** to access or store data. By maintaining a modular approach, the system supports efficient updates, troubleshooting, and potential scaling for future needs. Each component performs a distinct role within its respective layer, contributing to an organized, user-friendly, and robust printing service solution for HCMUT.

## 4 Implementation - Sprint 1

### 4.1 Our Repository

We have setup an online repository using Github. This is the link to our [repository](#).

### 4.2 Adding documents

You can view our requirements, diagrams and the website itself in the repository

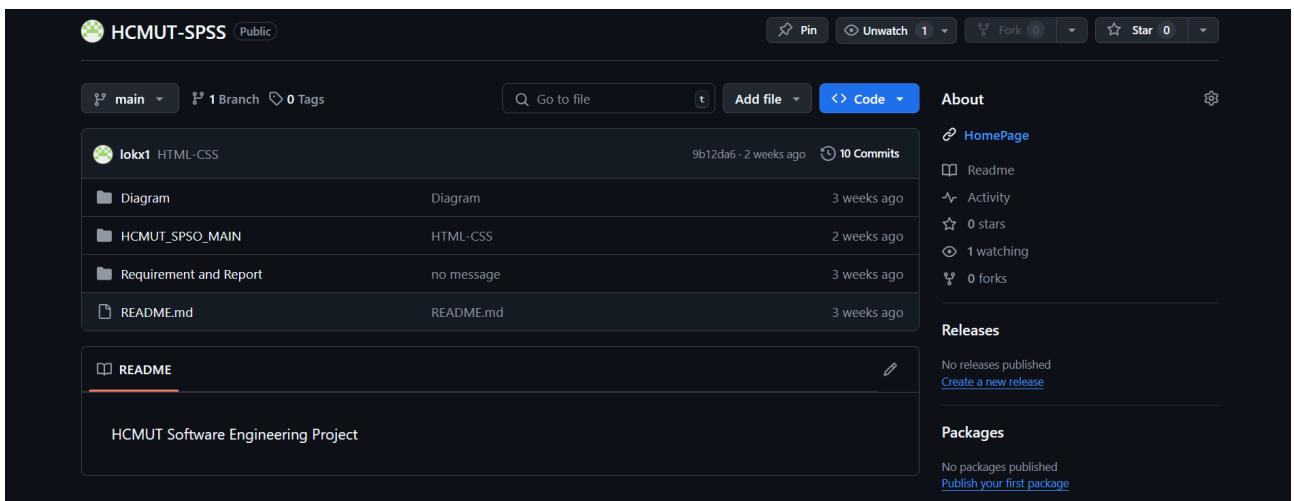


Figure 4.1: Our Repository

### 4.3 Usability Test

In order to proceed the test, a survey is generated for feedback collection from people experiencing our website. Within the test, the usability and interaction stability is checked by every person on their affordable platform, mainly split into Laptop/PC and mobile devices.

The survey is made by listing available general opinion, each participant rates every option from 1 to 5 stars, corresponding to agreement rate from participants.

#### 4.3.1 Summarization of feedback:

##### a. About Login Page

- The UI is easily interacted with and has an affordable look.

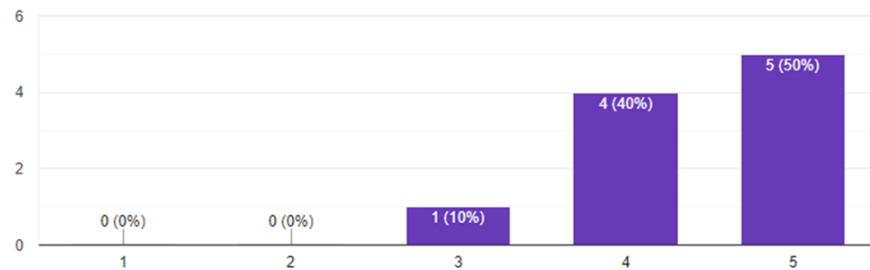


Figure 4.2: Feedback on the UI interaction and look of the Login page

- The UI does not cause/causes fewer optical issues.

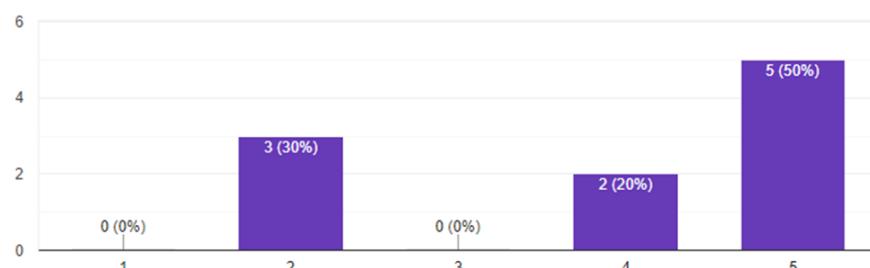


Figure 4.3: Feedback on optical issues of the Login page

- The UI flexibility is highly sufficient.

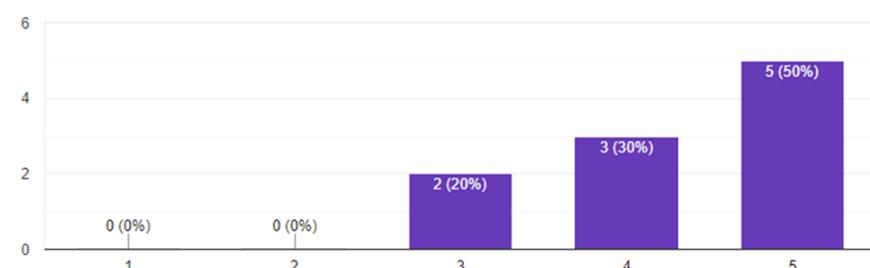


Figure 4.4: Feedback on UI flexibility of the Login page

- There are fewer issues/additional bugs during display/interaction.

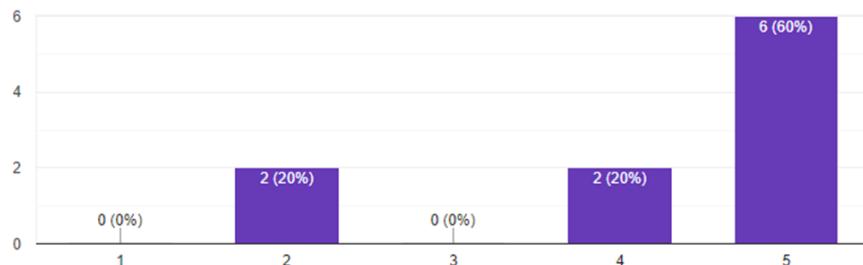


Figure 4.5: Feedback on display issues/interaction of the Login page

### b. About Student Pages

- The UI is easily interacted with and has an affordable look.

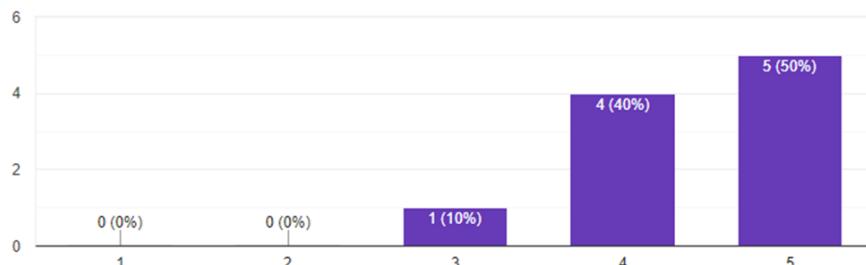


Figure 4.6: Feedback on the UI interaction and look of the Student pages

- The UI does not cause/causes fewer optical issues.

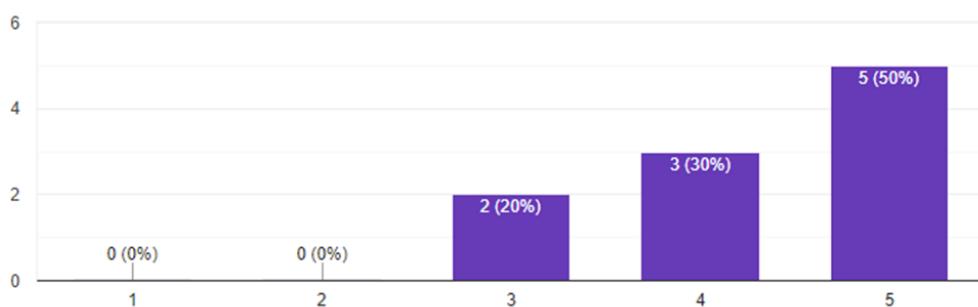


Figure 4.7: Feedback on optical issues of the Student pages

- The UI flexibility is highly sufficient.

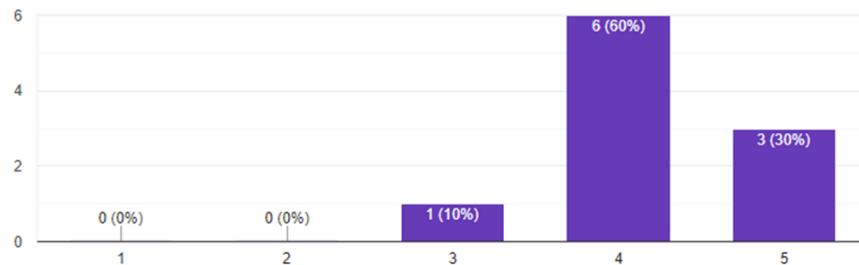


Figure 4.8: Feedback on UI flexibility of the Student pages

- There are fewer issues/additional bugs during display/interaction.

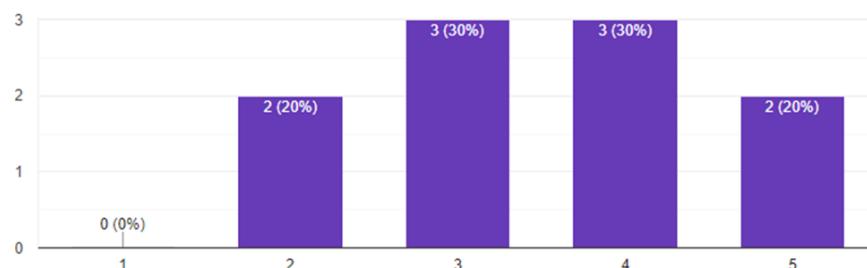


Figure 4.9: Feedback on display issues/interaction of the Student pages

- The paper price is affordable.

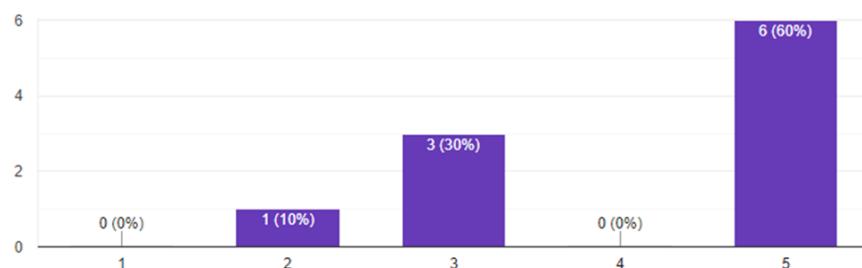


Figure 4.10: Feedback on paper price of the Student pages

### c. About Admin Pages

- The UI is easily interacted with and has an affordable look.

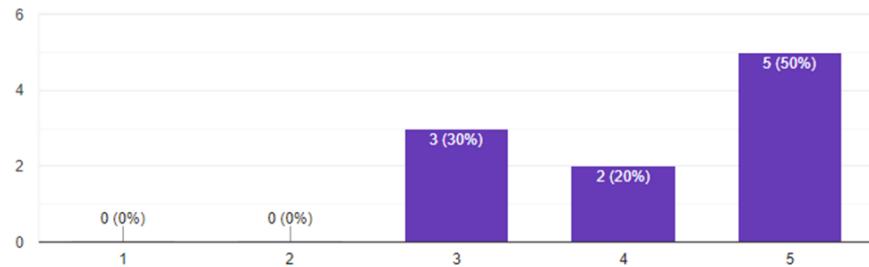


Figure 4.11: Feedback on the UI interaction and look of the Admin pages

- The UI does not cause/causes fewer optical issues.

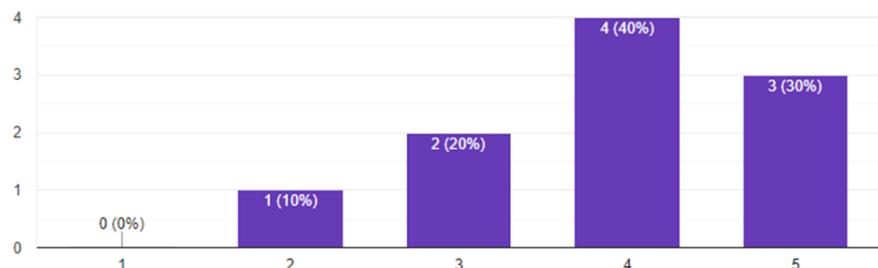


Figure 4.12: Feedback on optical issues of the Admin pages

- The UI flexibility is highly sufficient.

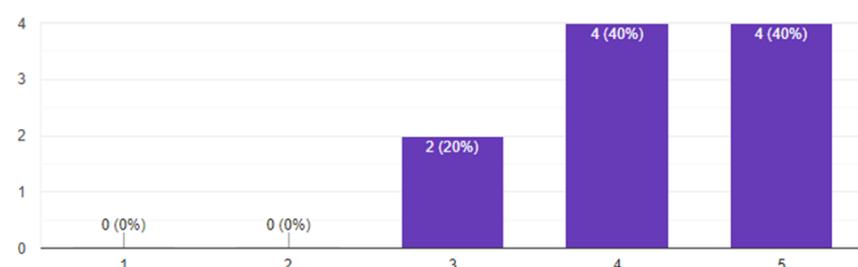


Figure 4.13: Feedback on UI flexibility of the Admin pages

- There are fewer issues/additional bugs during display/interaction.

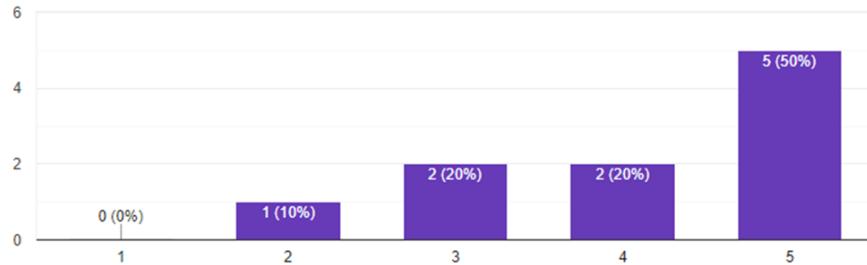


Figure 4.14: Feedback on display issues/interaction of the Admin pages

- The settings are easily set up.

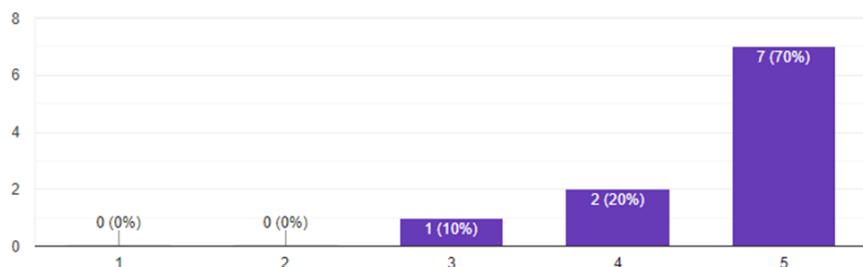


Figure 4.15: Feedback on the ease of setting up the Admin pages

**Conclusion** Our user interface fits well with most participants' devices. Generally, participants are satisfied with how the website displays, which is less likely to cause optical issues. In addition, as every page's layout is distributed wisely, there are minor cases that may cause an unusual display. Furthermore, the website's basic functions work well with no errors.

## 5 Implementation - Sprint 2

After a careful review of the survey that was administered and a comprehensive analysis of the options that survey participants offered, it is clear that our website requires particular changes that are intended to address needs that have been identified. These changes are necessary to maintain the best possible functionality for the entire website and to improve accessibility in general. Below is a list of optimizations that have been applied to our website.

## 5.1 Develop MVP 2

### 5.1.1 Printing Service

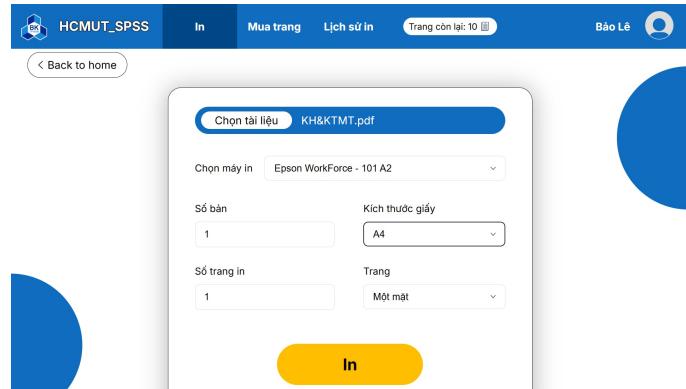


Figure 5.1: Component Diagram - Whole System

- In the event that a file is not uploaded and the user attempts to initiate the print command, an alert will be generated to notify the user of the omission.
- Integrate an additional feature allowing users to specify custom pages for printing.
- Implement a functionality enabling users to ascertain the current inventory of available paper, thereby enhancing user awareness of remaining resources.
- Enable users to choose from a wider selection of paper sizes, which will lead to a more varied selection of printing options.
- Provide users the choice between single- and double-sided printing to increase the flexibility of their printing configurations.

### 5.1.2 Paper Purchase Page

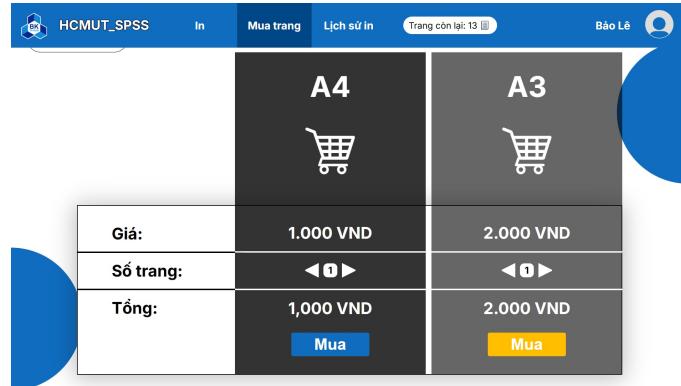


Figure 5.2: Component Diagram - Whole System

- Include a shopping cart feature to make user transactions for the purchase of paper easier.
- Make changes to the shopping interface so that customers can buy different kinds of paper, expanding the range of options within the framework for making purchases.

### 5.1.3 Printing History Page

The screenshot shows a user interface for viewing printing history. At the top, there are search fields for 'Tổng số trang đã sử dụng: 76', 'Mã số máy in: MSMI', and date ranges 'Phạm vi thời gian: DD/MM/YYYY - DD/MM/YYYY'. Below this is a table of print jobs:

Thời gian	Tòa nhà	Phòng	Số trang	MSMI	Tên tệp
14:05:06 01/12/2024	A2	101	1x A4	1	Đề_Ktra.pdf
18:15:34 29/11/2024	A2	101	1x A3	1	W5_RelationalAlgebra.pdf
18:14:36 29/11/2024	A2	101	1x A4	1	W5_RelationalAlgebra.pdf
18:14:17 29/11/2024	A2	101	1x A3	1	Đề_Ktra.pdf
18:11:59 29/11/2024	A2	101	2 x A3	1	Đề_Ktra.pdf
18:11:17 29/11/2024	A2	101	2 x A3	1	CC06_Gr2_Ast1.pdf

Figure 5.3: Component Diagram - Whole System

- Integrate the student ID attribute into the historical data table of the SPSO.
- Incorporate the file name attribute into the student's history table.
- Enable the ability to filter individual students and printers by their respective IDs within the SPSO framework.

Our website is hosted through a Web Server. We've attached a link to our website. In order to access the web interface, please use the assigned credentials in the following format:

- **Username:** your BKEL username (e.g., bao.lequoc)
- **Password:** any password will work

#### 5.1.4 Printer Configuration

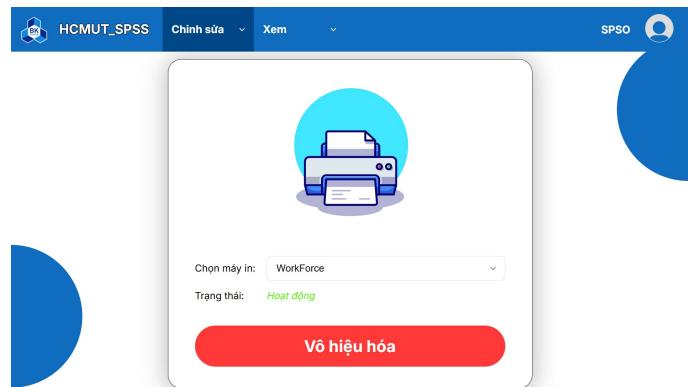


Figure 5.4: Component Diagram - Whole System

- This interface is part of a printer management system labeled **HCMUT\_SPSS**, designed for users to monitor and control printer functionality easily. The main panel displays a clean and user-friendly design with an illustration of a printer.
- Users can select a printer from the dropdown menu labeled (Choose printer), and view its status, quickly enable/disable the selected printer. This interface ensures efficient printer configuration and management through its simple yet functional layout.

## 5.2 Project Demonstration

For more insight into our project, you can visit this link to view the presentation slides.