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SOFTWARE ENGINEERING (CO3001)

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A smart printing service for HCMUT students

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1 List of member & workload

ID	Student ID	Full Name	Workload	Evaluation	Note
1	2152966	Dinh Việt Thành		16.66%	Leader
2	2152143	Dõ Duy Khương		16.66%	
3	2152591	Nguyễn Đình Thiên Huy		16.66%	
4	2153379	La Cảm Huy		16.66%	
5	2153488	Nguyễn Minh Khuê		16.66%	
6	2152040	Lê Hoàng Duy		16.66%	



2 Requirement elicitation

2.1 Domain context of the project

2.1.1 Project Overview

In the context of our program project, our domain resides within the educational realm of HCMUT, where we are developing an online printing service catering to all students across the campus network. This system is designed with the dual purpose of enhancing students' printing experiences and facilitating administrative tasks for school departments. To empower students with seamless printing capabilities, our system offers a feature-rich interface. Students can effortlessly locate printers situated throughout the campus, and access some details like printer ID, brand, and model. They can conveniently upload their documents, select their preferred printer, and fine-tune specific print settings such as page size, single or double-sided printing, and the number of copies they wish to produce. On the administrative front, the system equips Student Printing Service Officers (SPSOs) with valuable tools to manage and regulate printing activities. SPSOs can set constraints on student printing, including maximum page allowances per semester and approved file types for upload and printing. The system also diligently logs each student's printing history, simplifying tracking for both administrators and students alike. Furthermore, the system automates the generation and storage of periodic reports, with exclusive access granted to SPSOs for review. To ensure secure access, all students are required to authenticate through the HCMUT_SSO service before utilizing the web and application-based printing services.

2.1.2 Key stakeholders and their needs

During development for the Student Smart Printing Service (HCMUT_SSPPS) system, we will have several stakeholders, which include:

1. System design and development department:

The first group consists of the system management and control department, which is essential for maintaining and troubleshooting the system when issues arise during practical usage. They need to ensure the system is secure, reliable, and accessible to users.

2. Student Printing Server Officer (SPSO):

In addition, the Student Printing Server Officer (SPSO) also plays an important role in operating the system as well as providing printing services for students. SPSO requires a tool that can manage the printing service such as allowing what types of files are allowed to be uploaded, setting configurations for the printing service, and monitoring student printing activities through a log. And periodically report which printing services are used over a period of time. Printer management functions such as adding, turning on, and turning off printers are also essential needs.

3. Students:

Students are also considered an important stakeholder in the system because printing services are created to support them. They require a user-friendly system that allows them to print documents efficiently and directly through the app or the web. Specifically, their needs include the ability to locate active printers on campuses and specify printing options such as paper size, number of copies, etc. As well as payment services for additional purchases amount of paper that can be used in a semester.



4. The HCMUT_SSO authentication service:

One of the components of the main system is the authentication service, which can facilitate easy management and usage of the app for both Students and SPSO. This helps prevent external users from using the service and causing errors. This stakeholder needs to be implemented into the system to operate smoothly, and the system must also support data input in accordance with the format specified by the authentication service.

5. The Online payment system:

The final component for the student printing support service is the online payment system. To limit students from using the printing service excessively, the university has provided a partial fee for exceeding the printing limit. The online payment system is also a required part of the system, and the input data must be valid for the payment functions to complete the process of purchasing additional printing paper when the printing service exceeds the limit.

2.1.3 Benefits for stakeholders

The Student Smart Printing Service project (HCMUT_SSPPS) system offers significant benefits to both students and the university community. Firstly, users will enjoy enhanced convenience, with easy access to printers via the web or application, saving them valuable time and effort in the printing process. They can customize their printing preferences, including paper size, single or double-sided printing, and other properties, empowering them to optimize their printing experience and document format to suit their preferences. Additionally, the system provides a comprehensive view of their printing history, enabling users to track their usage, make informed decisions, and manage their printing costs effectively, thanks to the semester-specific page allocations provided by the school.

From the perspective of the Student Printing Service Officers (SPSOs), the system streamlines the management of the printing environment. SPSOs can efficiently monitor and adjust system configurations in line with the school's policies. They gain access to detailed logs and reports, simplifying the tracking of student printing activities and facilitating data-driven decision-making. Furthermore, SPSOs oversee financial transactions related to additional printing page purchases, ensuring sound financial management.

For HCMUT_SSO authentication service, this system serves as third-party software that utilizes the login functionalities provided by the university for student management. It facilitates easier access to the authentication API, eliminating the need for students to understand and authenticate using command-line prompts. It offers a user-friendly interface and environment for students.

As for the online payment system, it will serve as a bridge for transferring funds between students' bank accounts and the university's accounts, making it more convenient and time-saving for students to make payments. This eliminates the need to visit payment offices to complete transactions. Similar to the authentication system, the application will become a tool to assist students in using payment functions and formatting input data for payment APIs.



2.2 Functional and non-functional requirements

Based on the provided project description, we can infer the following functional and non-functional requirements for the Student Smart Printing Service (HCMUT_SSPS):

2.2.1 Functional requirements

1. For Students:

- Students should be able to log in to the application.
- Students should be able to upload document files for printing.
- Students should be able to choose a printer from the available options.
- Printing properties such as paper size, pages to be printed, one/double-sided printing, and number of copies should be selectable.
- Students should be able to view their printing history for a specified time period, including a summary of the number of printed pages for each page size.
- Each student should have a default number of A4-size pages for printing each semester.
- Students should be able to purchase additional pages through an online payment system.

2. For Student Printing Service Officer (SPSO):

- The system should log printing actions, including student ID, printer ID, file name, printing start and end time, and number of pages for each page size.
- The SPSO should be able to view the printing history (log) of all students or a specific student for a specified time period and for all or selected printers.
- The SPSO should be able to add, enable, and disable printers.
- Permitted file types for printing should be limited and configurable by the SPSO.
- The SPSO should be able to configure system settings, such as the default number of pages, dates for providing default pages to students, and permitted file types.
- The reports of the using of the printing system are generated automatically at the end of each month and each year and are stored in the system, and can be viewed by the SPSO anytime.

3. HCMUT_SSO authentication service:

- The HCMUT_SSO authentication service requests the student's username and password for logging into the application.
- All users have to be authenticated by the HCMUT_SSO authentication service before using the system.

4. Online payment system:

- The system should deduct the appropriate number of pages from a student's account balance when printing, considering A3 pages as equivalent to two A4 pages.
- The feature "Buy Printing Pages" of the system allows students to purchase additional pages, and they can make the payment through online payment systems like the university's BKPay system.



2.2.2 Non-Functional requirements

1. Usability:

- The users should be able to use the web effectively after 1-2 hours of training.
- The system should be available in both English and Vietnamese.
- The web should have 2 interfaces for students and SPSO.
- The system should have an intuitive and easy-to-use interface for students to navigate and interact with. To evaluate, we are using Usability Score (e.g., measured through user surveys or usability testing), and the target is at least 85% of users should rate the interface as "easy to use" or "very easy to use" in user satisfaction surveys.

2. Performance:

- Time for login should be less than 5 seconds.
- The system should provide quick responses when students perform actions like file uploads, printer selection, and specifying printing properties. The metric to evaluate it would be using Average Response Time (measured in milliseconds). The system should respond to user actions within 5 seconds on average.

3. Reliability:

- The failure rate of real-time access is 0.005 (5 fail access out of 1000 access).
- The system must work at all time.

4. Security:

- Alert for server infiltration.
- The integrity of data should be ensured, such as user information and other critical data, and minimize the risk of data loss or corruption.

5. Scalability:

- The system should be able to handle a large number of concurrent print requests, especially during peak times. To satisfy this requirement, we can use some metrics, for example, Concurrent Request Handling Capacity (measured as the maximum number of simultaneous print requests),...

2.3 Use-case diagram for whole system

2.3.1 Use-case diagram

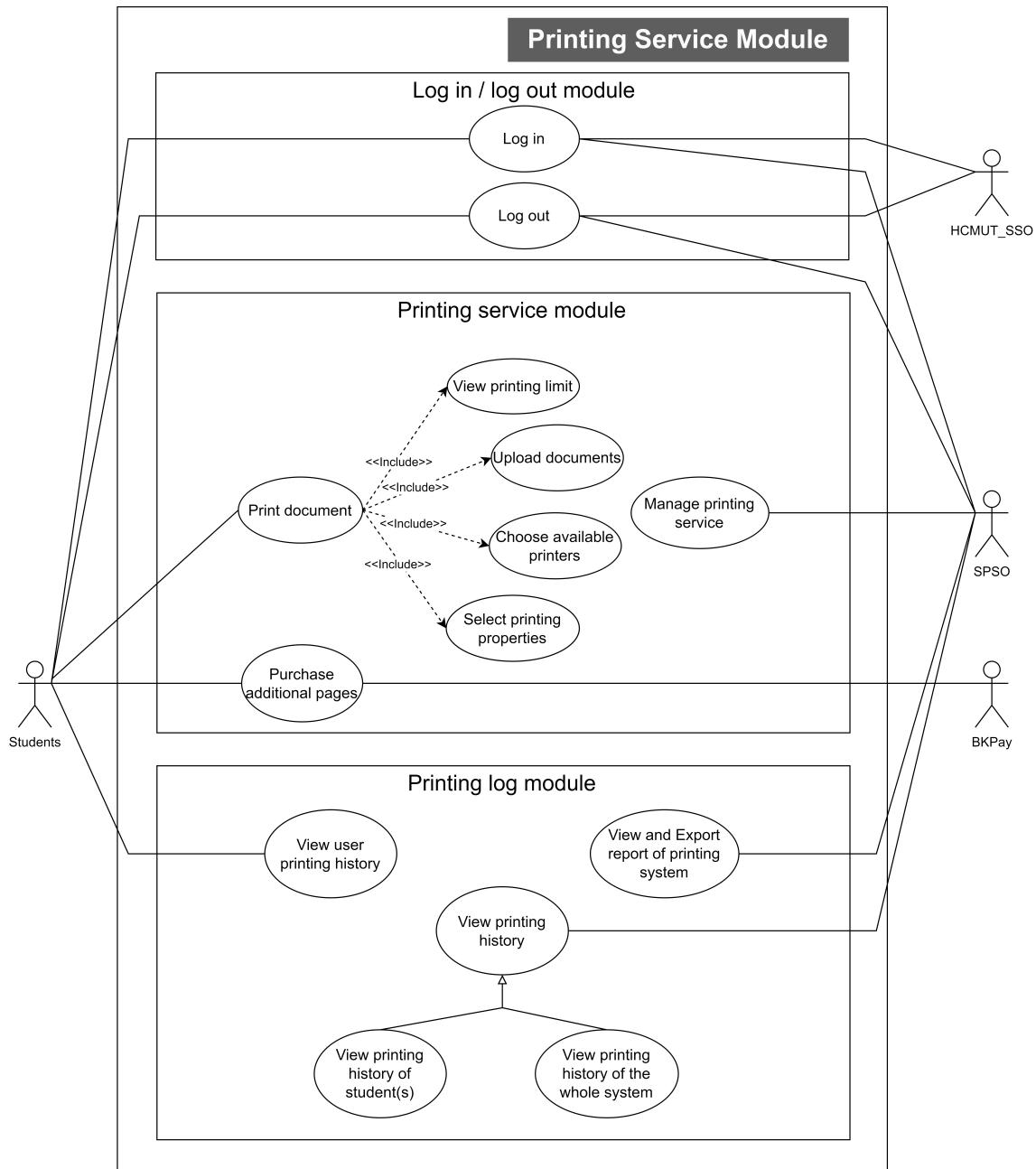


Figure 1: The use-case diagram for the whole system

For further inspection, please visit [this site](#).



2.3.2 Table description

Table of actors:

Actor ID	Actor	Description
1	Students	Students at HCMUT
2	SPSO	Student Printing Service Officer
3	BKPay	Payment system of HCMUT
4	HCMUT_SSO	Authentication Service of HCMUT_SSO

Table of use-cases:

ID	Use-case name	Description
1	Log in	Used by Students and SPSO to log in to SSPS
2	Log out	Used Students and SPSO to log out to SSPS
3	Print documents	Used by students to print documents
4	Upload documents	Used by students to upload the documents they want to print
5	Choose available printer	Used by students to choose the printer to be used among the available ones
6	Select printing properties	Used by students to choose desired printing properties such as paper size, one-/double-sided,etc
7	View printing limit	Used by students to check the number of remaining free pages
8	Purchase additional pages	Used by Students to purchasing additional pages once they reach the limit
9	Manage printing service	Used by SPSO to manage the configuration of the system
10	View user printing history	Used by students to view printing history for a time period
11	View printing history	Used by SPSO to view the printing history



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ID	Use-case name	Description
12	View printing history of a student	Used by SPSO to view the printing history of one/several student(s)
13	View printing history of the whole system	Used by SPSO to view the printing history of the whole system
14	Export report of printing system	Used by SPSO to export the report of the whole system

2.4 Printing service module use-case diagram

2.4.1 Use-case diagram

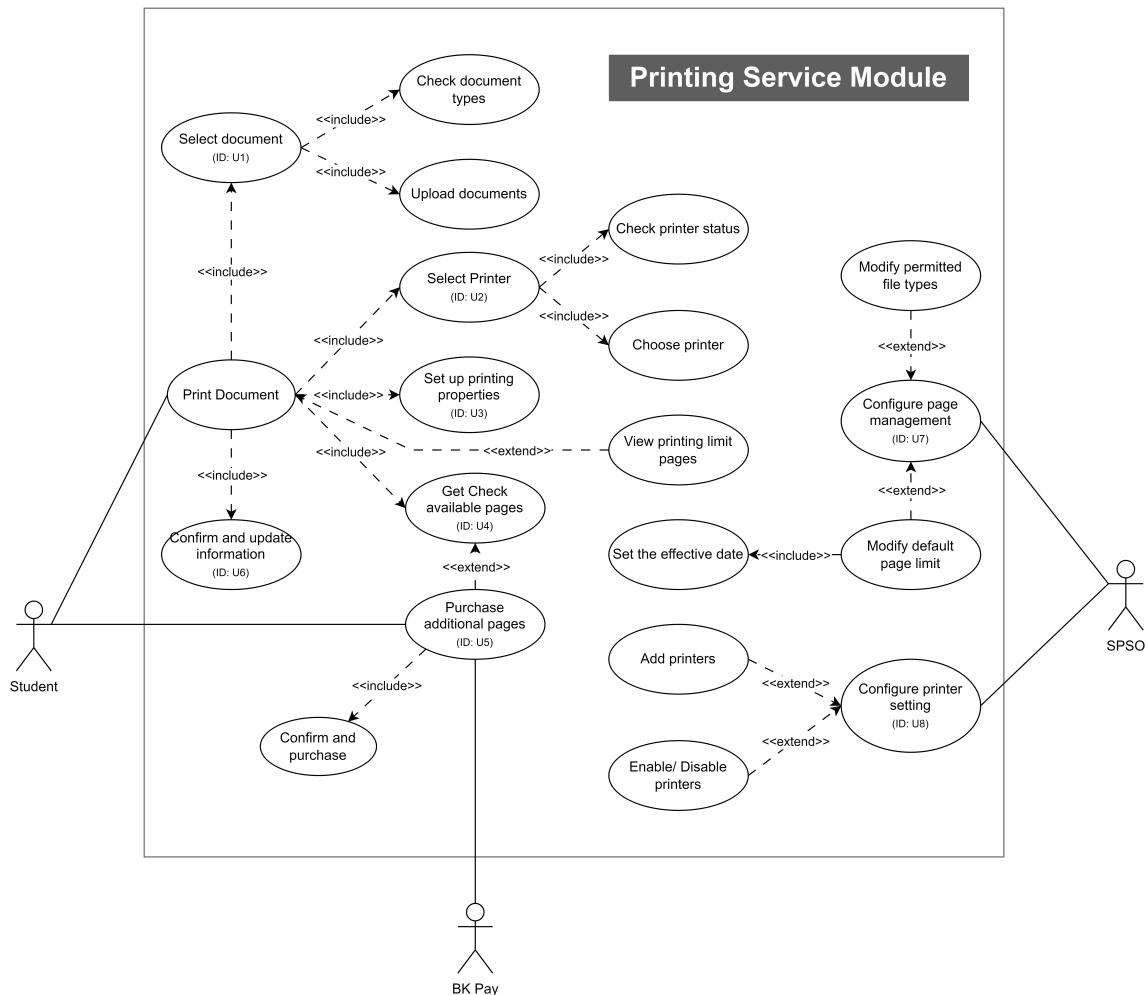


Figure 2: The use-case diagram for Printing service module

For further inspection, please visit [this site](#).



2.4.2 Table description

2.4.2.1 Upload Document Files

Use-case ID Use-case Name	U1 Upload Document Files
Use-case overview	This use case allows a student to upload a document file for printing to the HCMUT_SSPS system.
Actors	Student
Trigger	Student chooses the “Upload file” on the navigation bar.
Pre-conditions	<ul style="list-style-type: none">- The student has logged into the HCMUT_SSPS system.- The student has the necessary permission to upload documents.- The system and database are available.- The internet is available.
Post-conditions	The document file is successfully uploaded.
Normal flow	<ol style="list-style-type: none">1. The student selects the "Upload file" option in the user interface.2. The system presents a file upload interface, allowing the student to browse, select and confirm the desired document file from their local device.3. The system validates the file to ensure it meets the permitted file types and any other defined constraints.4. The system initiates the upload process, indicating the progress to the student.5. Once the upload is complete, the system confirms the successful upload.
Alternative flow	3a. If the selected file does not meet the permitted file types: The system displays an error message to the student, indicating that the file type is not allowed. The student is prompted to select a file with an acceptable file type.
Exception flow	If there is an unexpected system error (connection lost) during the upload process: The system displays an error message to the student, indicating the issue. The student can retry the upload.



2.4.2.2 Printer Selection

Use-case ID Use-case Name	U2 Printer Selection
Use-case overview	This use case allows a student to select a printer from the available options in the HCMUT_SSPS system.
Actors	Student
Trigger	Student chooses the “Select printer” in the user interface.
Pre-conditions	<ul style="list-style-type: none">- The student has logged into the HCMUT_SSPS system.- The student has uploaded a document file for printing.- The system and database are available.- The internet is available.
Post-conditions	The student has successfully selected a printer for their printing job.
Normal flow	<ol style="list-style-type: none">1. After uploading a document file, the system presents the student with a printer selection interface.2. The system displays a list of available printers, including their ID, brand/manufacturer name, printer model, and location.3. The student reviews the printer options and selects a preferred printer for their printing job.4. The system confirms the printer selection and notifies the student that the selection has been successfully submitted.
Alternative flow	2a. If there are no available printers: The system displays a message to the student indicating that there are no printers currently available for printing. The student is advised to try again later or contact the Student Printing Service Officer (SPSO) for assistance.
Exception flow	If there is an unexpected system error (connection lost) during the selection process: The system displays an error message to the student, indicating the issue. The student can retry the selection.



2.4.2.3 Printing Properties Selection

Use-case ID Use-case Name	U3 Printing Properties Selection
Use-case overview	This use case allows a student to select printing properties for their document in the HCMUT_SSPPS system.
Actors	Student
Trigger	Student chooses the “Select printing properties” in the user interface.
Pre-conditions	<ul style="list-style-type: none">- The student has logged into the HCMUT_SSPPS system.- The student has selected a printer for their printing job.- The system and database are available.- The internet is available.
Post-conditions	The student has successfully selected the desired printing properties for their document.
Normal flow	<ol style="list-style-type: none">1. After selecting a printer for the printing job, the system presents the student with options to configure printing properties.2. The system displays the available printing property options, including:<ul style="list-style-type: none">- Paper size (such as A4, A3, letter, etc.)- Number of pages (of the file) to be printed.- Single-sided or double-sided printing.- Number of copies to be printed.3. The student selects the available printing property options.4. The system validates the selected printing properties to ensure they are valid and supported by the selected printer.5. The system confirms the selected printing properties.
Alternative flow	4a. If any of the selected printing properties are not valid or not supported, the system displays an error message and prompts the student to make appropriate changes.
Exception flow	If there is an unexpected system error (connection lost) during the selection process: The system displays an error message to the student, indicating the issue. The student can retry the selection.



2.4.2.4 Checking Available Pages

Use-case ID Use-case Name	U4 Checking Available Pages
Use-case overview	This use case allows a student to check the number of available pages for printing in their account within the HCMUT_SSPPS system.
Actors	Student
Trigger	Student chooses the “Checking Available Pages” in the user interface.
Pre-conditions	<ul style="list-style-type: none">- The student has logged into the HCMUT_SSPPS system.- The student has selected printing properties.- The system and database are available.- The internet is available.
Post-conditions	The student is presented with the number of available pages for printing in their account.
Normal flow	<ol style="list-style-type: none">1. The student selects the "Check Available Pages" option in the user interface.2. The system retrieves the student's account information and displays the current number of available pages for printing.3. The system presents the available pages information to the student, specifying the number of A4-size pages remaining for the current semester. If the available pages are greater than or equal to the number of pages student desire to print, go to U6; else, go to U5.4. The system also provides information regarding any additional purchased pages and their corresponding balance.
Alternative flow	None.
Exception flow	If there is an unexpected system error (connection lost) during the checking available pages process: The system displays an error message to the student, indicating the issue. The student can retry the process.



2.4.2.5 Purchase Additional Pages

Use-case ID Use-case Name	U5 Purchase Additional Pages
Use-case overview	This use case allows a student to purchase additional pages if needed for printing in the HCMUT_SSPPS system.
Actors	Student, BKPay
Trigger	Student chooses the "Purchase Additional Pages" in the user interface.
Pre-conditions	<ul style="list-style-type: none">- The student has logged into the HCMUT_SSPPS system.- The student has checked the available pages and determined the need for additional pages.- The system and database are available.- The internet is available.
Post-conditions	The student has successfully purchased additional pages, and the corresponding page balance is updated in their account.
Normal flow	<ol style="list-style-type: none">1. The student selects the "Purchase Additional Pages" option in the user interface.2. The system presents the student with available page packages for purchase, displaying information about each package, including the number of pages included and the cost.3. The student selects the desired page package for purchase.4. The system initiates the payment process, integrating with a payment gateway or system.5. The student provides the necessary payment information and completes the transaction.6. The system prompts the student to confirm the purchase.7. The student confirms the purchase.8. The system verifies the payment and updates the student's account balance with the purchased pages.9. The system notifies the student that the purchase was successful, displaying the updated page balance.
Alternative flow	If the student decides not to proceed with the purchase: The student can cancel the transaction at any point before confirming the purchase, and the system will return to the previous state without making any changes.
Exception flow	If there is an issue with the payment processing or verification: The system displays an error message to the student, indicating the issue. The student can retry the payment process.



2.4.2.6 Print and Update Printing Information

Use-case ID Use-case Name	U6 Print and Update Printing Information
Use-case overview	This use case allows a student to print document file in the HC-MUT_SSPPS system.
Actors	Student
Trigger	Student chooses the “Print” in the user interface.
Pre-conditions	<ul style="list-style-type: none">- The student has logged into the HCMUT_SSPPS system.- The student has selected printing properties and has available pages to print.- The system and database are available.- The internet is available.
Post-conditions	The document is successfully printed by the selected printer.
Normal flow	<ol style="list-style-type: none">1. The student confirms the printing request.2. The system processes the printing request, sends the document file to the selected printer, and starts the printing job.3. The system deducts the appropriate number of pages from the student's account balance.4. The system logs the printing action, recording the student ID, printer ID, file name, printing start time, and the number of pages for each page size.5. The system notifies the student that the printing job has been successfully submitted and is in progress.6. The printer receives the print request, processes the document file, and prints the document according to the specified printing properties.7. The printed document is delivered to the output tray of the printer.8. The student retrieves the printed document from the printer's output tray.
Alternative flow	None.
Exception flow	If there is a technical error during the printing process: The system displays an error message to the student, indicating the issue. The student can retry the printing process.



2.4.2.7 Configure Page Management

Use-case ID Use-case Name	U7 Configure Page Management
Use-case overview	This use case allows the SPSO to configure the page management settings in the HCMUT_SSPPS system.
Actors	SPSO
Trigger	SPSO chooses the “Configure Page Management” in the user interface.
Pre-conditions	<ul style="list-style-type: none">- The SPSO has logged into the HCMUT_SSPPS system.- The system and database are available.- The internet is available.
Post-conditions	The page management settings are successfully configured and updated in the system.
Normal flow	<ol style="list-style-type: none">1. The SPSO selects the "Configure Page Management" option in the user interface.2. The system presents the SPSO with the current page management settings, including changing the default number of pages, the dates that the system will give the default number of pages to all students, the permitted file types accepted by the system, and any other relevant configurations.3. If the SPSO wants to update any settings, the system provides editable fields or options next to each relevant attribute.4. The system confirms the updated page management settings.5. The system applies the updated page management settings to all relevant processes and functionalities within the HCMUT_SSPPS system.
Alternative flow	<ol style="list-style-type: none">3a. If the SPSO decides not to make any changes: The SPSO can navigate away from the page management configuration section without making any updates, and the system will retain the current page management settings.
Exception flow	If there is an unexpected system error (connection lost) during the configuration process: The system displays an error message to the SPSO, indicating the issue. The SPSO can retry the configuration process.



2.4.2.8 Configure Printer Setting

Use-case ID Use-case Name	U8 Configure Printer Setting
Use-case overview	This use case allows the SPSO to configure the printer settings in the HCMUT_SSPPS system.
Actors	SPSO
Trigger	SPSO chooses the "Configure Printer Setting" in the user interface.
Pre-conditions	<ul style="list-style-type: none">- The SPSO has logged into the HCMUT_SSPPS system.- The system and database are available.- The internet is available.
Post-conditions	The printer settings are successfully configured and updated in the system.
Normal flow	<ol style="list-style-type: none">1. The SPSO selects the "Configure Printer Settings" option in the user interface.2. The system presents the administrator with the current printer settings, including the list of available printers and other relevant configurations.3. The SPSO makes the necessary changes (add/enable/disable printers) to the printer settings.4. The system confirms the updated printer settings.5. The system applies the updated printer settings to all relevant processes and functionalities within the HCMUT_SSPPS system.
Alternative flow	<p>3a. If the SPSO decides not to make any changes: The SPSO can navigate away from the printer setting configuration section without making any updates, and the system will retain the current page management settings.</p> <p>3b. The SPSO can enable or disable all printers by choosing "Enable all printers" or "Disable all printers" button.</p>
Exception flow	If there is an unexpected system error (connection lost) during the configuration process: The system displays an error message to the SPSO, indicating the issue. The SPSO can retry the configuration process.

2.5 Printing log module use-case diagram

2.5.1 Use-case diagram

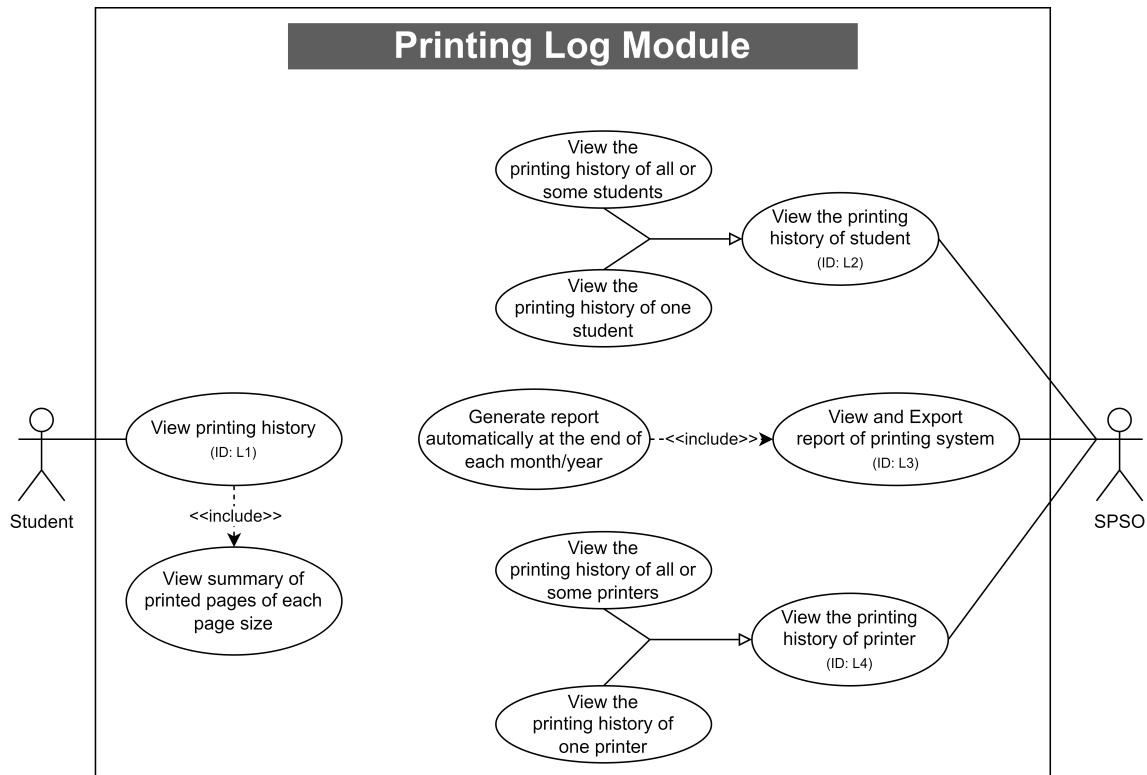


Figure 3: The use-case diagram for Printing Log module

For further inspection, please visit [this site](#).



2.5.2 Table description

2.5.2.1 View Printing History

Use-case ID Use-case Name	L1 View Printing History
Use-case overview	This use case allows a student to view their printing history in the HCMUT_SSPPS system.
Actors	Student
Trigger	Student chooses the "View Printing History" in the user interface.
Pre-conditions	<ul style="list-style-type: none">- The student has logged into the HCMUT_SSPPS system.- The system and database are available.- The internet is available.
Post-conditions	The student can review their printing history.
Normal flow	<ol style="list-style-type: none">1. The student selects the "View Printing History" option in the user interface and chooses the time period.2. The system presents the student with a list or summary view of their printing history, including details such as printing dates, document names, printer used, summary of printed pages of each page size, and any associated costs.3. If the student wants to view more detailed information about a specific printing activity, they can select the corresponding record or click on a "Details" button.4. The system expands the selected record or displays a new page with detailed information about the printing activity. Detailed information may include additional attributes such as printing start time, printing end time, printing status, and any relevant notes or comments.5. The student can navigate back to the summary view or list to continue reviewing other printing activities.6. The student completes their review of the printing history.
Alternative flow	2a. If the student's printing history is empty: The system displays a message indicating that the student has no printing history available.
Exception flow	If there is an unexpected system error (connection lost) while retrieving or displaying the printing history: The system displays an error message to the student, indicating the issue. The student can retry the process.



2.5.2.2 View the History of Student

Use-case ID Use-case Name	L2 View the history of student
Use-case overview	This use case allows the SPSO to view the printing history of student in the HCMUT_SSPOS system.
Actors	SPSO
Trigger	SPSO chooses the "View Student Printing Log" in user interface.
Pre-conditions	- The SPSO has logged into the HCMUT_SSPOS system. - The system and database are available. - The internet is available.
Post-conditions	The SPSO can review the printing history of the selected student or all students.
Normal flow	1. The SPSO selects the "View Student Printing Log" in the user interface and chooses the time period. 2. The system presents the SPSO with a search field or a list of students to choose from. 3. The SPSO enters the student's ID, name, selects the student from the list, or enters "All Students" to display all students. 4. The system presents the SPSO with a list or summary view of the student's printing history, including details such as printing dates, document names, printer used, number of pages, and any associated costs. 5. If the SPSO wants to view more detailed information about a specific printing activity, they can select the corresponding record or click on a "Details" button. 6. The system expands the selected record or displays a new page with detailed information. Detailed information may include additional attributes such as printing start time, printing end time, printing status, and any relevant notes or comments. 7. The SPSO can navigate back to the summary view or list to continue reviewing other printing activities of the selected student. 8. The SPSO completes review of the student's printing history.
Alternative flow	2a. If the selected student's printing history is empty: The system displays a message indicating that the student has no printing history available.
Exception flow	If there is an unexpected system error (connection lost) while retrieving or displaying the printing history: The system displays an error message to the SPSO, indicating the issue. The SPSO can retry the process.



2.5.2.3 View and Export report of Printing System

Use-case ID Use-case Name	L3 View and Export report of printing system
Use-case overview	This use case allows the SPSO to view and export reports containing data and statistics related to the printing system's history in the HCMUT_SSPPS.
Actors	SPSO
Trigger	SPSO chooses the "View Reports" in the user interface.
Pre-conditions	- The SPSO has logged into the HCMUT_SSPPS system. - The system and database are available. - The internet is available.
Post-conditions	The SPSO can view and export reports of the printing system's history.
Normal flow	1. The SPSO selects the "View Reports" option in the user interface. 2. The system presents the SPSO with a list of available reports or report categories which are generated automatically at the end of each month and each year. 3. The SPSO selects a specific report or report category from the list related to the printing system's history. 4. The system generates the selected report or displays a list of available reports within the category. 5. The SPSO selects the desired report from the list. 6. If the SPSO wants to export the report, the system provides an option to export the report in a preferred format such as PDF, CSV, or Excel. 7. The SPSO selects the desired export format. 8. The system generates the report in the selected format and initiates the download process. 9. The SPSO saves the exported report to a local or designated location.
Alternative flow	2a. If the selected report or report category does not exist or is unavailable. The system displays a message indicating that the requested report is not available or that no reports exist within the selected category.
Exception flow	If there is an unexpected system error (connection lost) during the generating or displaying of the report: The system displays an error message to the SPSO, indicating the issue. The SPSO can retry the configuration process.



2.5.2.4 View the History of Printer

Use-case ID Use-case Name	L4 View the history of printer
Use-case overview	This use case allows the SPSO to view the printing history of printer in the HCMUT_SSPPS system.
Actors	SPSO
Trigger	SPSO chooses the "View Printer Printing Log" in the user interface.
Pre-conditions	- The SPSO has logged into the HCMUT_SSPPS system. - The system and database are available. - The internet is available.
Post-conditions	The SPSO can review the printing history of the selected printer or all printers.
Normal flow	<ol style="list-style-type: none">1. The SPSO selects the "View Printer Printing Log" in the user interface and chooses the time period.2. The system presents the SPSO with a search field or a list of printers to choose from.3. The SPSO enters the printer's ID, name, selects the printer from the list, or enters "All Printers" to display all printers in the list.4. The system presents the SPSO with a list or summary view of the printer's printing history, including details such as printing dates, document names, student used, number of pages, and any associated costs.5. If the SPSO wants to view more detailed information about a specific printing activity, they can select the corresponding record or click on the "Details" button.6. The system expands the selected record or displays a new page with detailed information about the printing activity. Detailed information may include additional attributes such as printing start time, printing end time, printing status, and any relevant notes or comments.7. The SPSO can navigate back to the summary view or list to continue reviewing other printing activities of the selected printer.8. The SPSO completes review of the printer's printing history.
Alternative flow	2a. If the selected printer's printing history is empty: The system displays a message indicating that the printer has no printing history available.
Exception flow	If there is an unexpected system error (connection lost) while retrieving or displaying the printing history: The system displays an error message to the SPSO, indicating the issue. The SPSO can retry the process.

3 System Modelling

3.1 Activity Diagram

3.1.1 Printing Service Module

3.1.1.a Diagram

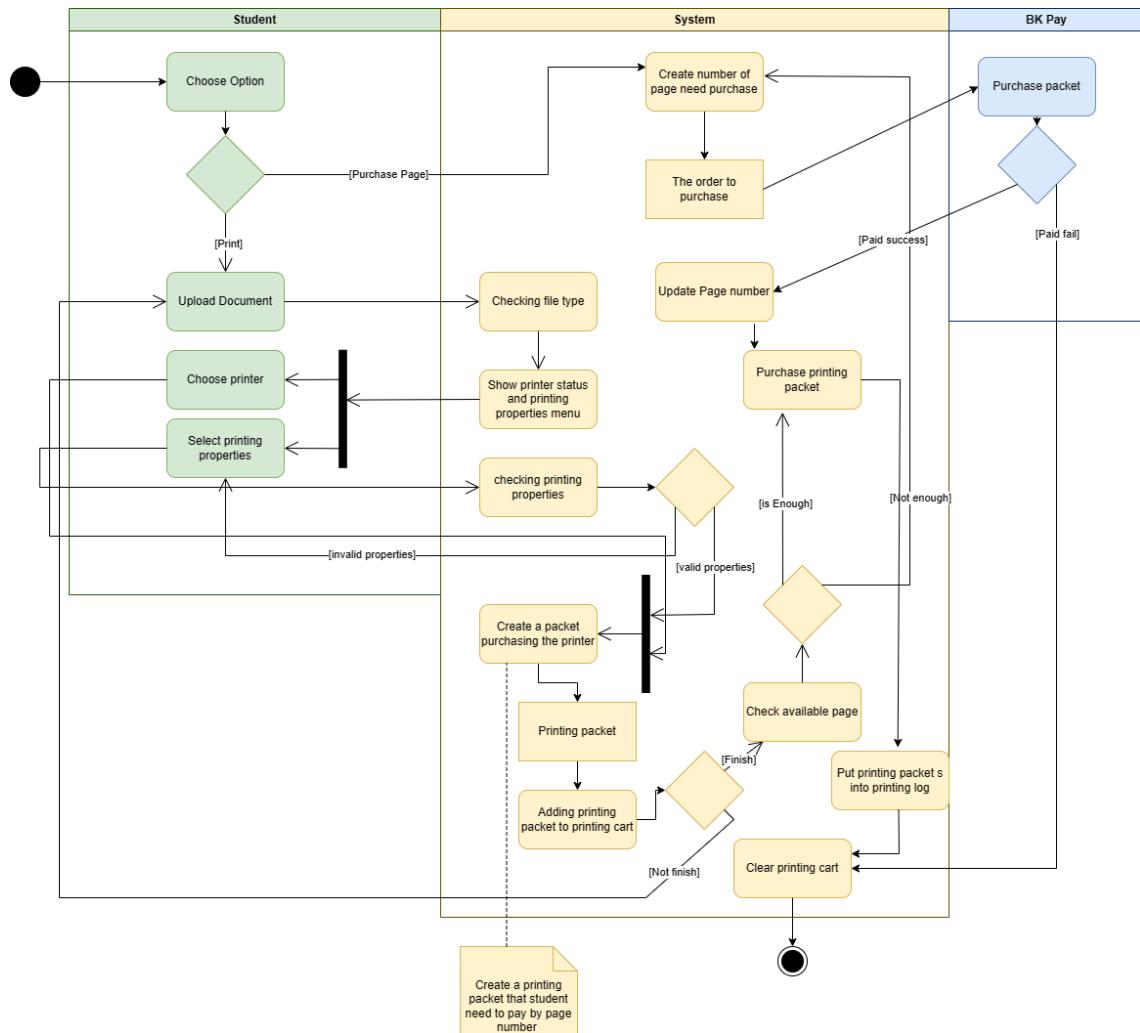


Figure 4: The activity diagram for Printing module - Student

For further inspection, please visit [this site](#).

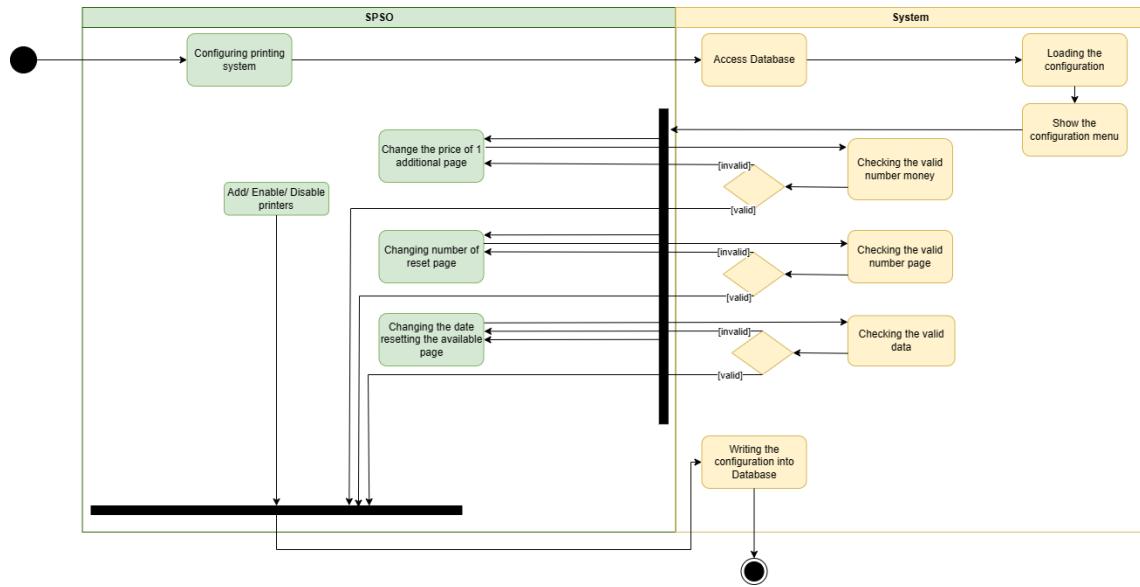


Figure 5: The activity diagram for Printing module - SPSO

For further inspection, please visit [this site](#).

3.1.1.b Description

In our diagram, we partition it into two sub-diagrams: one for student users and the other for SPSO users. The first one is from the perspective of a student:

1. The student user is presented with a choice between two options: "Purchase Page Service" or "Printing Service" for their next course of action.
2. In the event that the student selects "Printing Service," they will have the ability to upload a document to the web page. Subsequently, the system will conduct a file type validation check. If the uploaded file is found to be invalid, the system will inform the student and prompt them to select another file.
3. For valid files, the system will direct the student to a menu page where they can configure various printing properties and choose from available printers. The system will continuously validate the chosen properties as the student makes changes. If any properties are deemed unacceptable by the system, an error message will be generated, requiring the student to make necessary adjustments. If all properties are accepted, along with the file intended for printing, the system will package them into a print job and add it to the cart.
4. Students also have the option to create multiple print jobs before initiating the actual printing process. Once all the required printing settings are in place, the student can notify the system that they have completed their selections and are ready to commence the printing process.
5. Upon initiating the printing function, the system will first verify the student's available page quota to ensure they have a sufficient number of pages. If the student lacks the necessary page balance, the system will transition into a payment mode. It will calculate the total



number of pages required for the student's printing needs and generate a bill (referred to as an "order to purchase"). This order will be transmitted to BK Pay for payment processing. After a successful transaction, the system will perform a sequence of actions, including updating the student's remaining page count, purchasing all items in the cart, updating student's remaining page count in the database as well as their transaction history, clearing the cart. In cases where the student possesses an adequate page balance, the system will directly proceed with the purchase, update cart clearance.

6. If any issues arise during the transaction process, the system will refrain from purchasing any items in the cart, remove all items from the cart, and halt the service.
7. When a student selects the "Purchase Page Service" exclusively, the system will offer the student the flexibility to specify the number of pages they wish to purchase. Subsequently, a bill for the page purchase will be generated and transferred to BK Pay. If the transaction is successful, the system will update the student's remaining page count and execute a series of steps similar to those in the printing service, with the exception of the cart being empty. This ensures that students need not worry about a reduction in their page balance when using the page purchasing service alone.

The second one is from the perspective of an SPSO:

1. When the SPSO selects the "Configure Printing System" service, the system will proceed to access the configuration database to retrieve the most recent configuration. This configuration will then be displayed on the user interface (UI) for the SPSO's convenience.
2. Following that, the SPSO possesses the ability to adjust a range of properties associated with the printing service. These properties encompass configuring page purchase prices, enabling or disabling printers, and integrating new printers into the system as the university introduces additional printing choices. Furthermore, the SPSO can customize the default number of pages allocated to students and specify the date on which the system will reset the page count for students. Any alterations to these properties will be subjected to a validation process. Upon the system's notification that the user has completed all modifications and all property changes have been accepted, they will be documented in the configuration database, resulting in the system's update.

3.1.2 Printing Log Module

3.1.2.a Diagram

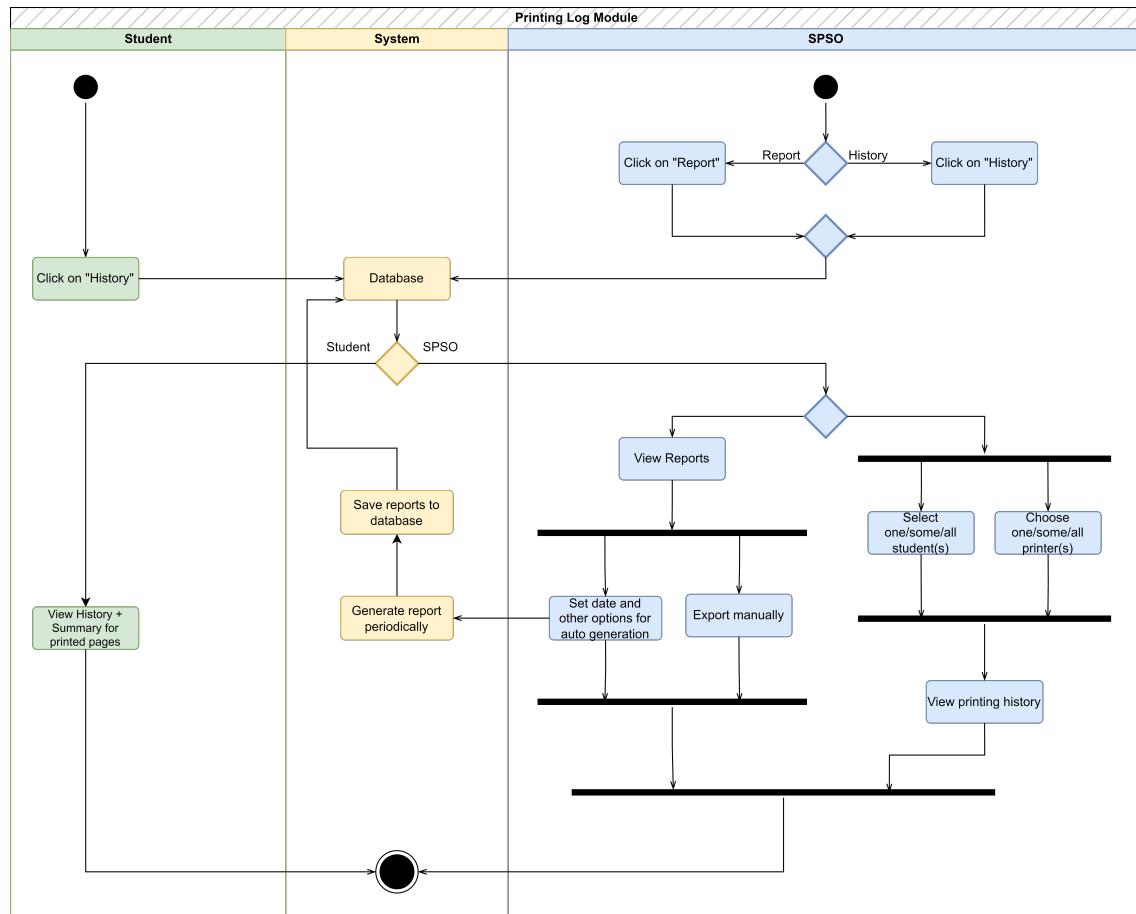


Figure 6: The activity diagram for Printing Log module

For further inspection, please visit [this site](#).

3.1.2.b Description

The activity diagram demonstrates the process for viewing the printing history (log) from the perspective of a student and an SPSO:

1. User can access to printing history by clicking on "History", and a request will be sent to the database to retrieve the logs.
2. Once triggered, the database will send the necessary information back to the user.
3. If the user is a student, then the response will include his/her own printing history and the summary of the number of printed pages for each page size. The student is also able to apply filters to the records, such as for datetime.



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4. If the user is an SPSO, the system response will provide the printing history of the entire system. The SPSO has the option to access the printing history of all students or a specific student within a defined time period (from one date to another) and for all or a selection of printers. Additionally, the SPSO can apply various filters to refine the search results.
5. If the user is an SPSO, he/she can access to report system by clicking on "Report".
6. In accordance with step 4, the SPSO will can examine real-time reports within the system and can access previous reports as well. Moreover, the SPSO will be able to manually export the selected report or configure specific dates and other options for automated report generation. Once generated, the report will be stored in the database for future reference.

3.2 Sequence Diagram

3.2.1 Printing Service Module

3.2.1.a Diagram

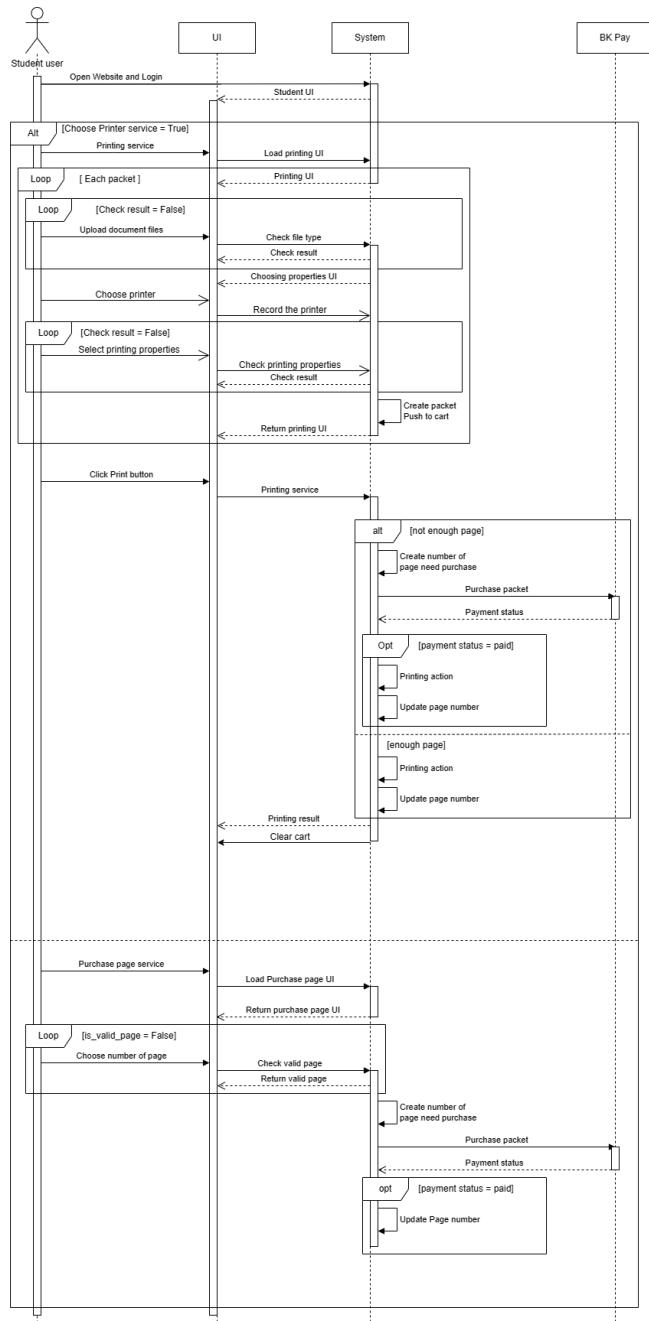


Figure 7: The sequence diagram for Printing module - Student

For further inspection, please visit [this site](#).

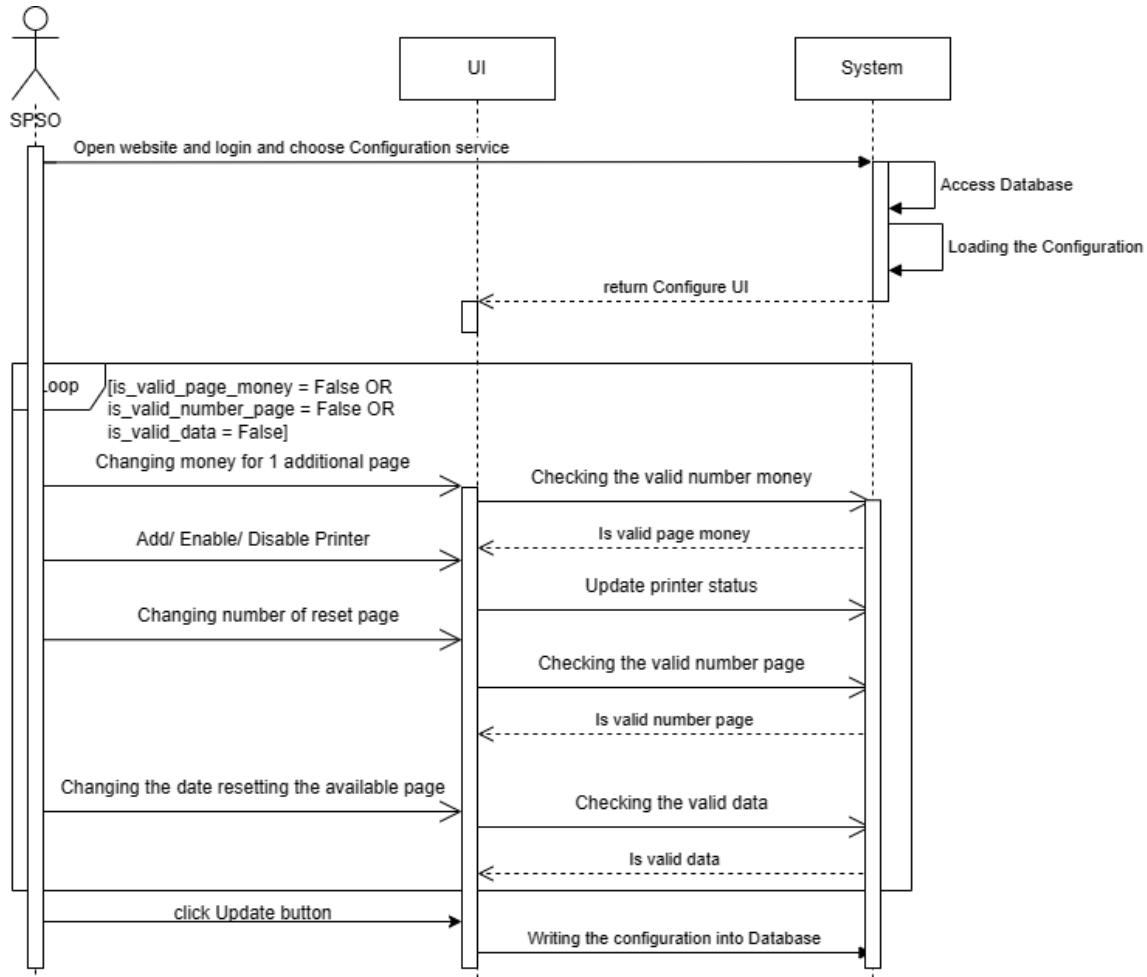


Figure 8: The sequence diagram for Printing Log module - SPSO

For further inspection, please visit [this site](#).

3.2.1.b Description

Our sequence diagram is further divided into two sub-diagrams. The first one is from the perspective of a student:

1. The system initiation for a Student User begins with the user opening the website and logging in. In response, the system provides the Student User with the UI webpage tailored to their needs. Subsequently, the user can access the printer service, prompting the UI to send a request to the system for the printing UI. Users can then submit files and adjust the necessary properties. A loop is established to validate the file type and properties, ensuring the selection of valid settings. Once all printing requirements are submitted, the student clicks the "Print" button on the UI. The UI forwards all requests to the system to initiate the printing process.



2. Initially, the system checks if the student has a sufficient page balance. If not, it generates a bill and directs BK Pay to handle the payment procedure. The transaction result is subsequently relayed back to the system for further processing. If the result is successful, the system proceeds with the printing tasks, such as printing all requirements, logging the student's printing history, updating the remaining page count, and returning the printing service status to the UI. It also requests the UI to clear the cart. In the event of an unsuccessful transaction, the system returns the printing service status and prompts the UI to clear the cart. If the user has enough remaining pages, the system bypasses BK Pay and directly initiates the printing process. It then relays the results and clears the cart through the UI.
3. For users opting for the "Purchase Page Service," they initiate this service through a UI request. Users can choose the number of pages, which the system subsequently validates. Upon confirming the validity of the page count, the system engages BK Pay to complete the transaction and updates the student's remaining page count.

The second one is from the perspective of an SPSO:

1. The system's operation commences when the SPSO opens the website. It accesses the database to load the most recent configuration and returns the configuration UI to the web browser.
2. The SPSO is empowered to modify a range of properties, with each change subjected to system validation. Once all properties are validated, and the user clicks the "Update" button, the system receives the updated configuration. It writes this configuration into the database, affecting the necessary system update.

3.2.2 Printing Log Module

3.2.2.a Diagram

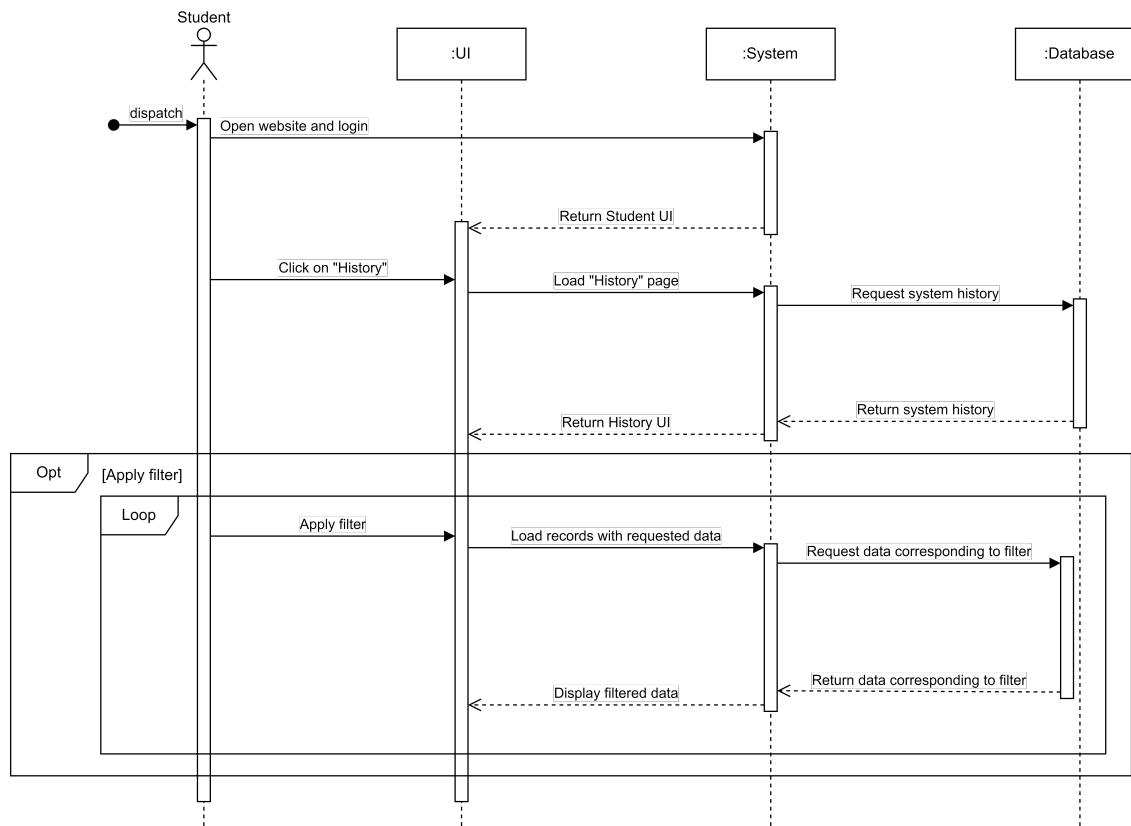


Figure 9: The sequence diagram for Printing Log module - Student

For further inspection, please visit [this site](#).

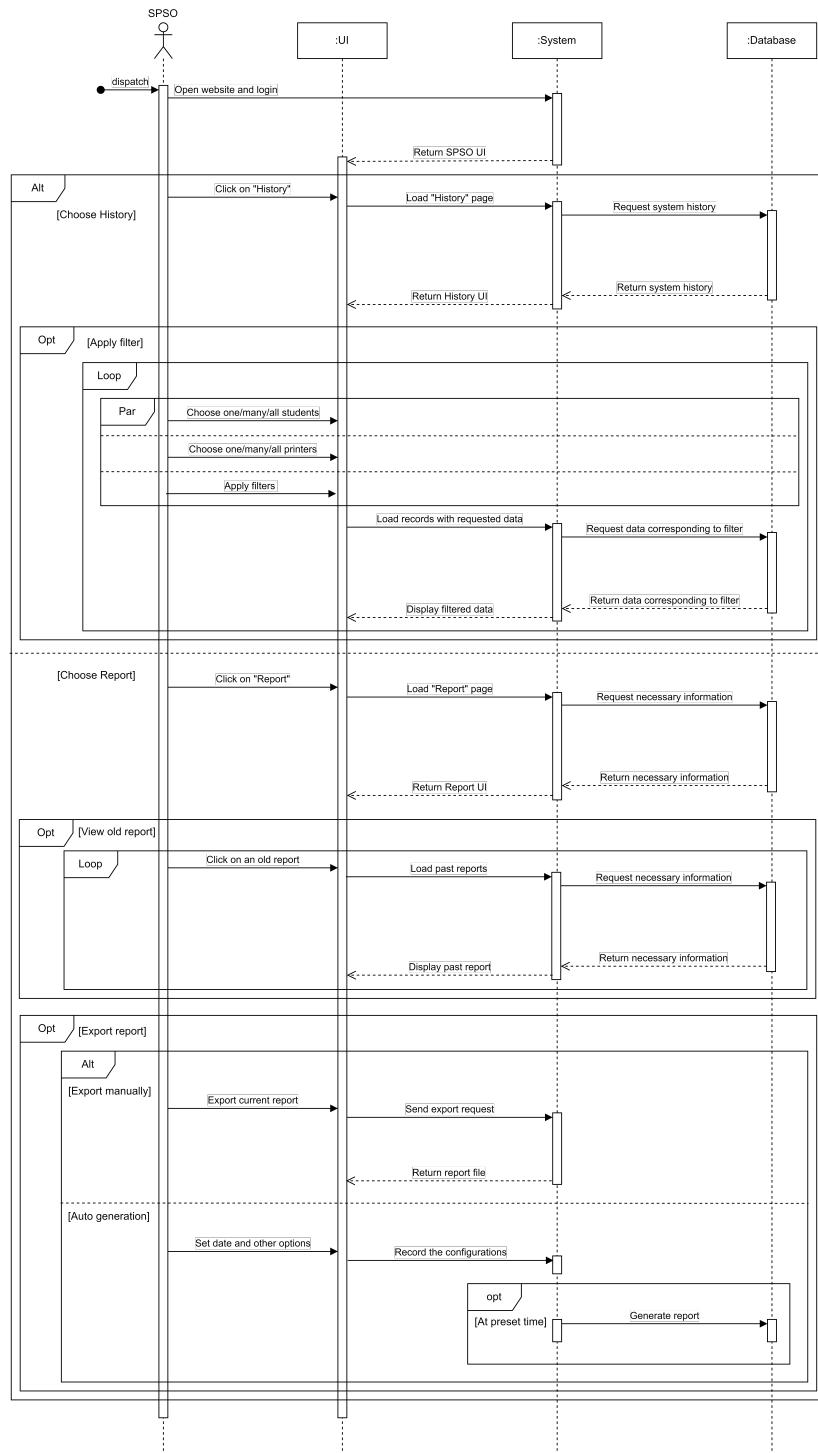


Figure 10: The sequence diagram for Printing Log module - SPSO

For further inspection, please visit [this site](#).



3.2.2.b Description

The sequence diagrams demonstrate the process for viewing the printing history (log) from the perspective of a student and an SPSO. The first diagram is the perspective of a student:

1. Upon logging into the website as a student, the server will present the student's user interface (UI) to the user.
2. When the user clicks on "History", a request is sent to the database to retrieve the logs. Upon receiving the request, the database sends the required information back to the user, and the server returns the history UI.
3. The user will be able to view both the printing history and a summary detailing the number of printed pages for each page size.
4. For further inspection, the user can utilize the available filters. Each time a filter is applied, a request will be sent to the database to retrieve the required information.

The second diagram is the perspective of an SPSO:

1. Upon logging into the website as an SPSO, the server will present the SPSO's user interface (UI) to the user.
2. When the user clicks on "History", a request is sent to the database to retrieve the logs. Upon receiving the request, the database sends the required information back to the user, and the system also returns the history UI.
3. The user will be able to view both the printing history of the entire system. For further inspection, the user can choose one/many/all students, one/many/all printers, or utilize the available filters. Each time a filter is applied, a request will be sent to the database to retrieve the required information.
4. If the user wants to review the reports, they can click on the "Report" button. A request will be sent to the database to retrieve necessary information, and the system also returns the Report UI.
5. Within the "Report" section, the user can examine the current real-time report of the system, as well as access and review older reports that have been stored in the database.
6. The user has the option to manually export the reports or configure the dates and other options for automated report generation. Once generated, the report will be saved in the database for future reference.

3.3 Class Diagram

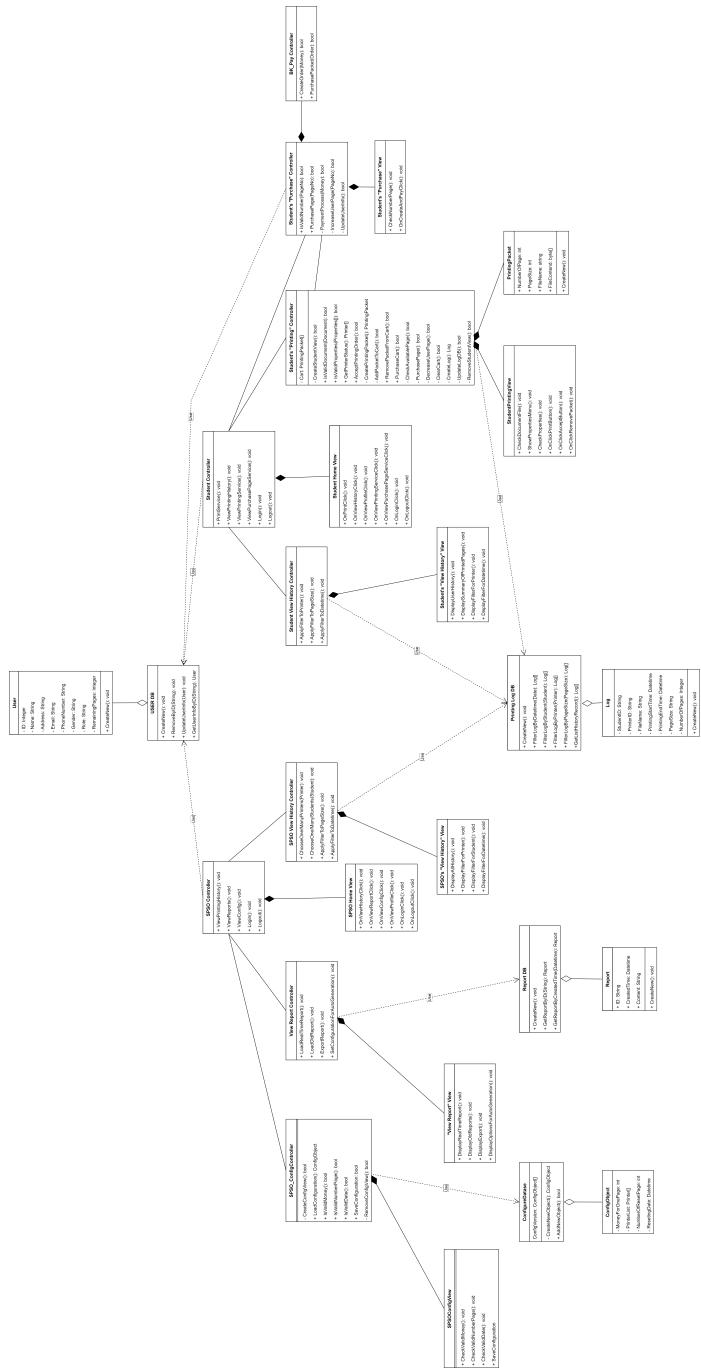


Figure 11: The class diagram for the whole system

For further inspection, please visit [this site](#).



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3.4 User Interface

Page: Login mode

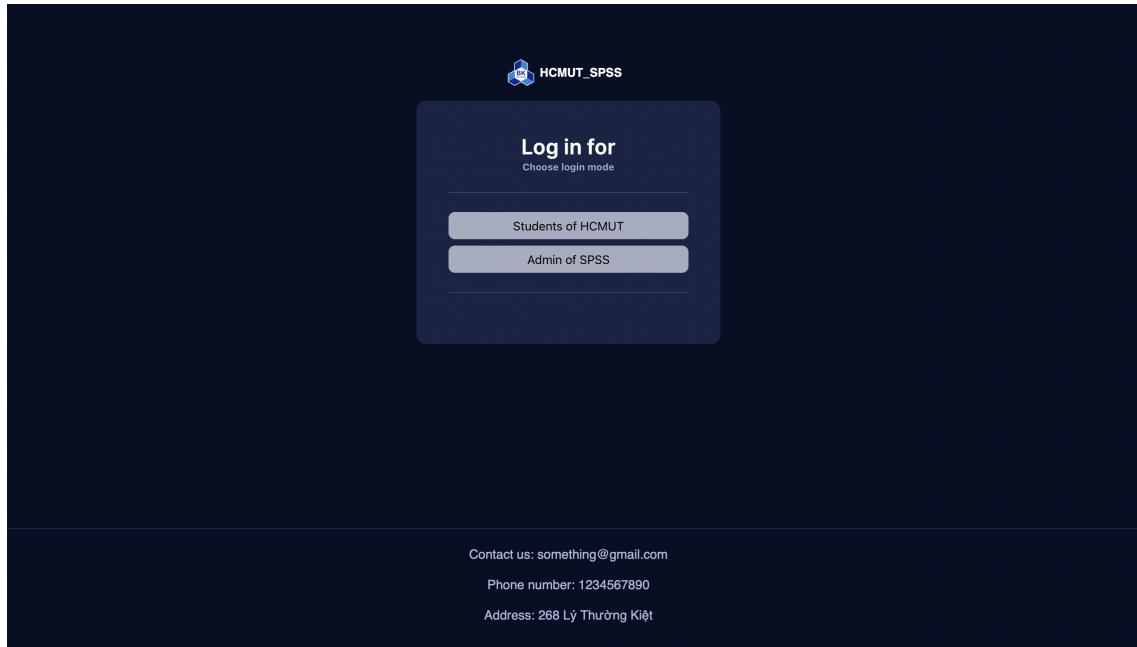


Figure 12: The User interface for Login mode page

- Button: Choose to log in as a student (user) or SPSO (admin)



Page: Student login and Admin login

The screenshot shows the 'Student log in' interface. It features a dark blue header with the 'HCMUT_SPSS' logo and the text 'Central Authentication Service'. Below this is a section titled 'Student log in' with the sub-instruction 'Fill in your log in details below.' It contains two input fields: 'Your email' and 'Your password', each with a placeholder text inside. Below these fields are two buttons: 'Log In' and 'Clear'. At the bottom of this section is a link 'Change password?'. To the right of the form is a 'Please note' section with detailed instructions about single sign-on, the HCMUT account, and security guidelines.

Figure 13: The User interface for Student login page

The screenshot shows the 'Admin log in' interface. It has a similar dark blue header with the 'HCMUT_SPSS' logo and 'Central Authentication Service' text. The 'Admin log in' section includes the same 'Fill in your log in details below.' instruction, 'Your email' and 'Your password' input fields, and 'Log In' and 'Clear' buttons. A 'Change password?' link is also present. The 'Please note' section to the right contains the same information as Figure 13, including the single sign-on policy and security tips.

Figure 14: The User interface for Admin login page



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- Form: Enter username and password to log in

Page: Home

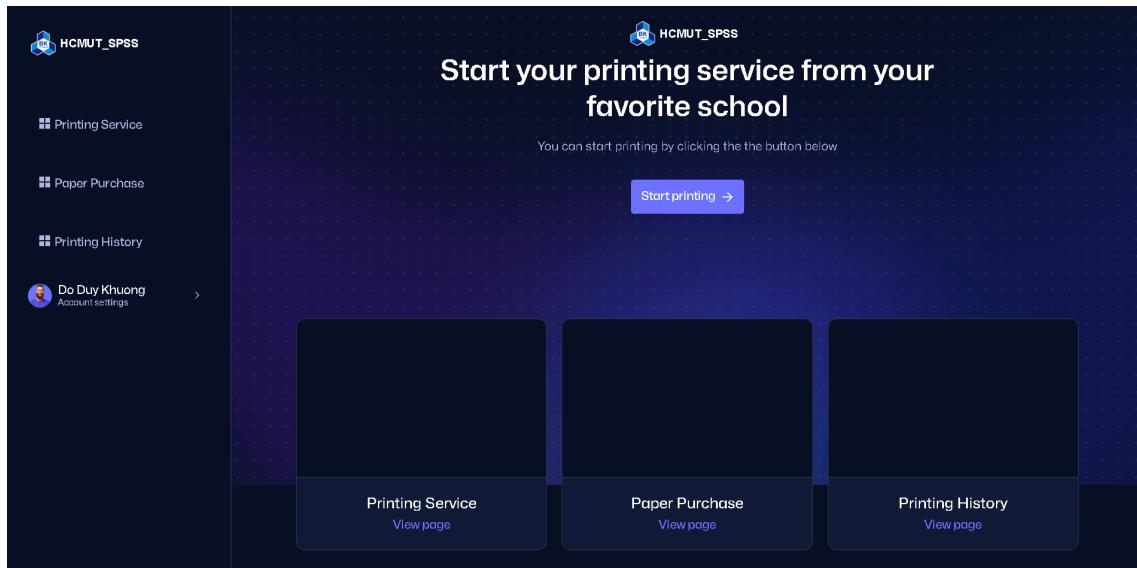


Figure 15: The User interface for Home page

- Navigation bar
 - Menu: Print, Purchase Paper, View History
 - User account setting
- Print button: If user logs in, the user will be directed to the Printing Service.



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Page: Printing Service

The screenshot shows a dark-themed web application for printing services. On the left, a sidebar menu includes 'Printing Service' (selected), 'Paper Purchase', 'Printing History', and a user profile for 'Do Duy Khuong'. The main content area features a 'Welcome back, Khuong' message and a sub-header 'You can print your files / documents here'. A central form for printing specifications includes fields for 'Pages' (set to 'Odd-pages only'), 'Copies' (empty), 'Layout' (set to 'Portrait'), 'Destination' (set to 'Printer 1-B4 Building'), and a file upload field ('Choose File | No file chosen'). A large blue button labeled 'Start printing' is at the bottom of the form. At the bottom of the page, there is contact information: 'Contact us: something@gmail.com', 'Phone number: 1234567890', and 'Address: 268 Lý Thường Kiệt'.

Figure 16: The User interface for Printing Service page

- Form

- Pages: All pages, Odd-pages only, Even-pages only, Custom
- Copies: Number of copies
- Layout: Portrait, Landscape
- Printer: Printer options (printer ID + destination)
- File: Place for uploading file
- Button: start printing



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Page: Paper Purchase

The screenshot shows a user interface for paper purchase. On the left, there's a sidebar with icons for Printing Service, Paper Purchase (selected), and Printing History. A user profile for 'Do Duy Khuong' is also visible. The main area is titled 'Purchase Papers' with the sub-instruction 'You can buy your papers here'. It features a 'Pick a plan' section with three options: 'Small 2k' (selected), 'Medium 10k', and 'Large 20k'. Each option has a 'Purchase now' button. Below this is a 'Features' table:

Features	1 paper	6 papers	13 papers
Number of papers	1 paper	6 papers	13 papers
Bonus papers	1 papers	3 papers	3 papers
Availability of purchase	✓	✓	✓

At the bottom, it says 'Contact us: something@gmail.com' and shows the URL '127.0.0.1:5500/pricing.html'.

Figure 17: The User interface for Paper Purchase page

- Table

- Purchase packets: 1 paper - 2,000 VND, 6 papers - 10,000 VND, 13 papers - 20,000 VND
- Button: Purchase now (direct to BK Pay)

Page: Printing History



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Welcome back, Khuong

View your history here

Create report

Jan 2024

Print ID	Printer Number	Date	Status	Paper Printed
#4321	Number 8 AV Library	Jan 30, 2024	Delivered	10 papers
#4320	Number 4 B1 Building	Jan 27, 2024	Canceled	3 papers
#4319	Number 2 C6 Building	Jan 21, 2024	Canceled	1 paper

Contact us: something@gmail.com
Phone number: 1234567890
Address: 268 Lý Thường Kiệt

Figure 18: The User interface for Printing History page

- Table

- Ordered number
- Printer ID + destination
- Date
- Status
- Printed paper

Page: Printing Report



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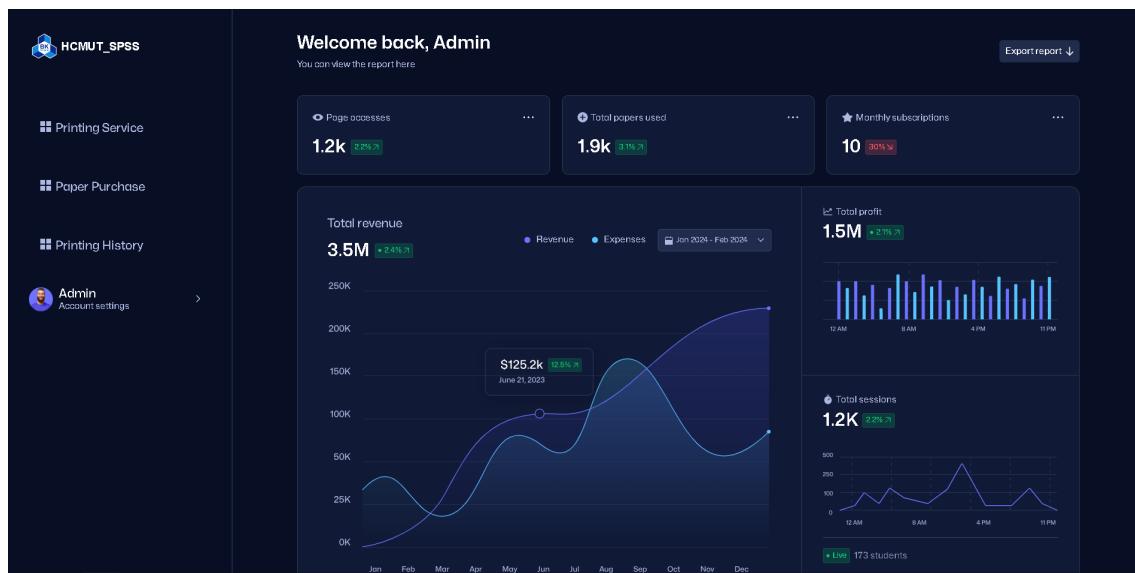


Figure 19: The User interface for Printing History page

- Table
 - Total printed paper
 - Service Access
 - Total revenue and Total profit