Software Requirements Specification

for

A smart printing service for students at HCMUT

Version 1.2 approved

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Revision History

Name	Date	Reason For Changes	Version
Bao Le	15/09/2024	Create new	1.0
Full group	21/09/2024	Modify requirement elicitation, define domain context, stakeholders, and needs. Point out the benefits of the system and list functional/non-functional requirements.	1.1.0
Full group	29/09/2024	Modify the use-case diagram and clarify the details of use cases in specific modules.	1.1.1
Full group	02/10/2024	Create new content for task 2	1.2.0
Full group	10/10/2024	Initial commit for activity diagrams, sequence diagrams, class diagram, and MVPs.	1.2.1
Bao Le, Thien Loc	11/10/2024	Modify activity diagrams and sequence diagrams	1.2.2
Tien Hung, Thanh Phat	20/10/2024	Modify MVP and wireframe models in Figma	1.2.3
Tan Phong	21/10/2024	Modify class diagrams	1.2.4
Full group	25/10/2024	Finalize task 2	1.2.5
Full group	04/11/2024	Create new task 3	1.3.0
Full group	06/11/2024	Modify task 3	1.3.1
Full group	08/11/2024	Finalize task 3	1.3.2

1. Task 1: Requirement elicitation (1.1, 1.2)

1.1 Domain Context

Nowadays, in universities, although learning becomes more paperless, printing is still on demand for students and faculty members. However, there are a few problems for students to find a good printing service, such as:

1. Production cost continues to rise
2. Time-consuming with confirming the layout, materials, design of documents
3. Wasteful, manual, error-prone steps
4. Slow services
5. Out-dated technology

Hence, website HCMUT_SSPS is built for serving students in HCMUT to print their documents via the printers around the campus. This not only helps students save time by viewing the document, tracking the progress online and integrating with BKPay website; but also helps the Student Printing Service Officer manage the student's printing activity.

1.2 Stakeholders and Needs

Student Printing Service Officer (SPSO)

- Description: The SPSO Staff are responsible for managing and supervising student printing activities within the system, as well as the resources used in this system. They also manage what content will be allowed to print, control and moderate the printing activities in the university.
- Needs: The SPSO Staff need a tool system that is simple, easy to understand and operate. That system must also have enough functionality to manage and moderate the printing activities like: Can get the student ID, lecturer or other staff who are involved in the printing activities, can check the condition of the printer online, can summarize statistics at each printer.
- User story: As a SPSO Staff, I wish to manage and moderate all the printer, printing activities, student, lecturer and other staff. Can turn on/off the printer online.

Students, lecturer, and staffs

- Description: All kinds of students in the university: Undergraduate student, Master student, Doctor of Philosophy student, Exchange student, the lecturer and all kinds of staff in the university that have demand to use the printer service. They can use whatever printer in the university as long as it operates normally and is authorized to operate. Also the content printed must be allowed by SPSO. Each semester each student will be given a default number A4 pages. They can buy more A4 pages on the BKPAY if they run out of a given number of pages.
- Needs: They need to print documents, books, references or anything relating to printing.
- User story: As a student, lecturer or staff of the university, I wish to use the printer easily by simply logging in to the BK account. And when I want to print more paper, I also wish to pay through an online payment easily.

Bach Khoa Payment System (BKPAY)

- Description: The BKPAY system helps the SPSO collect fees when students, faculty, or staff want to print additional paper. They simply calculate the number of paper the user paid and then update the number paper that can be printed by the account's user.
- Needs: The BKPAY system wants to link to the bank of each user and can manage the data which define the number of papers each user currently has.
- User story: As a BKPAY system, I want to have an interface to link to the bank of each user and manage their number of papers.

Printer provider

- Description: The Printer Provider is responsible for supplying and maintaining the printers used in the HCMUT_SSPS. This includes installing and configuring printers, ensuring they are operational, and addressing any hardware-related issues that arise. They are also responsible to fix and replace printers whenever they get notified about those compromise printers.
- Needs: They need to have permission from the university to install the printer. They will also need an account to have an announcement on what printer is in bad condition.
- User story: As a Printer Provider, I wish to have permission from the university to install and set up the printer around the university, and I wish to have something that will immediately notify me so that i can fix it on time.

1.3 Benefits of the System

Student Printing Service Officer (SPSO):

- The HCMUT SSPS helps the SPSO staff control the printing system effectively. The printing resources are managed by real-time printer monitoring, remote management, and detailed users' statistics. With this printing system, the printing waste is reduced and it witnesses an enhancement in overall resource management, a reduction in unauthorized or unnecessary printing.

Students, Lecturers, and Staff:

- For these groups of users, the system ensures smooth access to printing services by using university login, optimizing the printing process. With single sign-on, the system reduces the time spent managing several accounts, improving convenience. Moreover, the system allows for easy online payment through BKPAY, eliminating the need for paying in cash and enabling quick addition of printing quotas.

Bach Khoa Payment System (BKPAY):

- BKPAY benefits from integration with HCMUT-SSPS as it facilitates streamlined management of printing payments. The system automatically updates user balances based on transactions, reducing administrative overhead. Digital payment systems like BKPAY increase efficiency by automating financial processes, improving

accuracy, and minimizing the chances of errors. Furthermore, this integration helps ensure transparent transactions, improving trust between the users and the university.

Printer Provider:

- For the printer provider, HCMUT-SSPS offers a proactive maintenance system where printers automatically send alerts for repairs or maintenance. This immediate notification system allows providers to address issues before they escalate, reducing downtime and extending the lifespan of printers. Proactive maintenance has been linked to lower operational costs and improved equipment reliability.

1.4 Functional Requirements

Student Printing Service Office (SPSO)

- Send the report of the usage of the printing system automatically at the end of each month and each year and stored in the system (only SPSO can access it).
- Can add/enable/disable multi printers.
- Manage the configuration, comprise adjusting the number of pages each user can print per semester, specify which type of file that users allow to upload and print (configuration if needed).
- Allow the SPSO view the printing history of all students or a specified student within a defined date range.
- Provide access to all user accounts.
- Permit users to print some number of page when it does not exceed their account balance (one A3 page is equivalent to two A4 pages).
- Display the status of all printers.

Student, Lecture or Staff

- Can view their printing log for a time period with a summary of the number of printed pages for each page size, Printer ID, time).
- The system stored the printing log of each user.
- Users can access and view their information.
- Can choose which printer they wish to use.
- Can purchase additional pages by using BKAY integration within the system.
- Documents can be uploaded onto the system.
- Changed the printing properties before printing (paper size, pages (of the file) to be printed, one-/double-sided, number of copies, etc).
- Select the time they want to receive their prints.
- Send an email when you finish printing to confirm (Include any changes made in BKPAY).
- Users may be allocated a default number of A4-size pages for printing.

Bach Khoa Payment System (BKPAY)

- The system shall provide a secure interface to link users' bank accounts to their BKPAY accounts.

- Users shall be able to add/remove/update their linked bank account information.
- The system must support secure authentication and authorization for bank transactions.
- The system must allow users to make payments for additional paper using their linked bank accounts.
- Track and display users' current paper balance, updating it after successful transactions.
- Provide users access to their payment and printing transaction history.
- Notify users of any payment issues, and handle retries when necessary.
- Ensure secure handling of sensitive data.
- Allow administrators to manage user accounts, paper balances, and view transaction logs.

Printer Provider

- The system must allow the Printer Provider to request permission from the university for printer installation and setup.
- Once permission is granted, the system should provide the Printer Provider with the necessary information to set up the printer.
- The system must automatically notify the Printer Provider when a printer is in bad condition or requires maintenance.
- Notifications must be sent immediately, specifying the printer's location and the type of issue (e.g., hardware malfunction, low ink, etc.).
- The system must allow the Printer Provider to monitor the operational status of all printers in real time, showing which are functional and which need attention.
- The system must allow the Printer Provider to schedule maintenance visits and track the status of repairs or replacements.
- The system must ensure that the Printer Provider has appropriate access to the university's network for printer setup, monitoring, and maintenance activities.

1.5 Non- Functional Requirements

- The system are provided through a web-based app and a mobile app
- Can work from a period time
- The system should work smoothly during the required hours
- If have an app, support both IOS and Android
- The app should be accessible for all types of users
- Printing time must be fast, and the friendly interface and easy to use
- Fix bug and maintain the system
- The system should be regularly maintained to fix bugs and keep it running smoothly
- Security and access management
- Protect user data with encryption
- Handle more users without slowing down

2. Use-case Diagrams (1.3)

2.1 Use-case Diagram for the Whole System

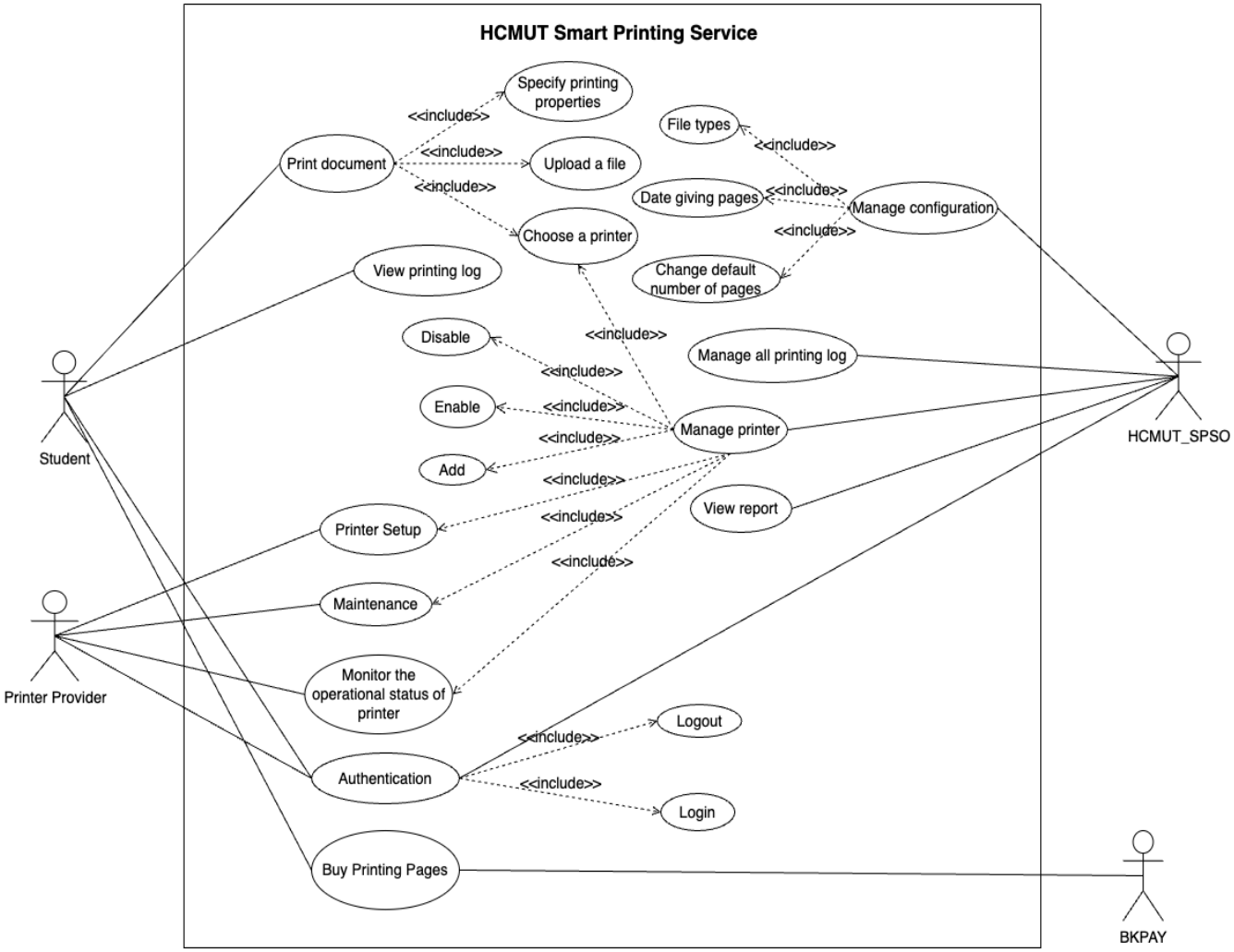


Figure 1: *Use case diagram for HCMUT Smart Printing Service*

2.2 Use-case Diagram for Students Module

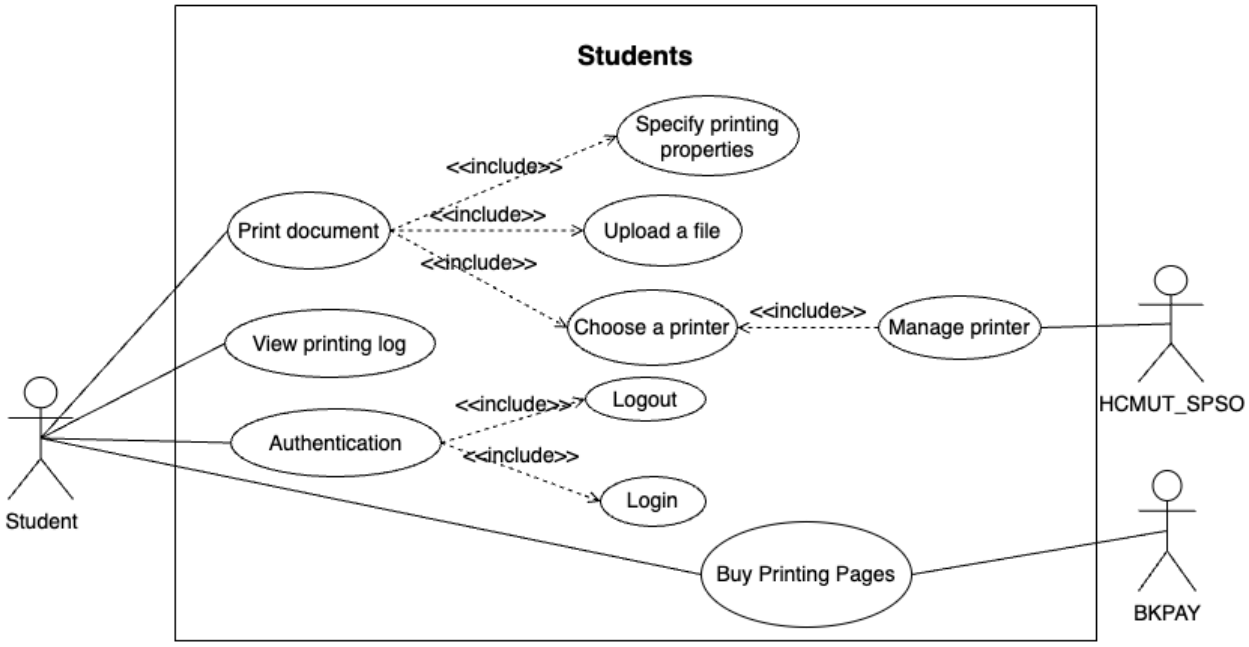


Figure 2: *Use case diagram for Students Module*

2.3 The Details of Use Cases in Students Module

1. Use case Authentication

ID and Name	UC-1 Authentication
Created by	Nguyen Tien Hung
Date created	28/09/2024
Actor	Student, Print Provider and the SPSO
Description	All users have to be authenticated by the authentication service before using the system
Trigger	All users want to login to access the system and logout to exit the system.
Preconditions	1. User's account has been created

	2. The account's privilege has been specified 3. User's device can communicate to the system 4. Users wanting to logout must already login first
Postconditions	Student, Print Provider and the SPSO can access the services that they want
Normal Flow	1. User access to the system 2. The system requires username and password for login 3. Authenticating successfully. 4. User can access their service based on their privilege
Alternative flow	2.1. In case of a user forgetting their password, the user can choose the option "forget the password". The system sends a link to the default email for confirmation and resetting password.
Exceptions	3.1. Mismatching username and password will be notified to the user.

2. Use case Print document

ID and Name	UC-2 Printing Documents
Created by	Nguyen Thanh Phat
Date created	27/09/2024
Actor	Student
Descriptor	Student can print documents by uploading a document file onto the system, choose a printer, and specifying the printing properties such as paper size, pages (of the file) to be printed, one-/double-sided, number of copies, etc.
Trigger	Student wants to print the document.
Preconditions	1. Student has been authorized by the system. 2. Student's device can be able to communicate to the system. 3. Printer service is available to the students.

Postconditions	1. Student's request is processed successfully. 2. The printing log has been recorded.
Normal Flow	1. Student accesses to the printing service web page. 2. Student uploads a document file onto the system and customizes the pages needed to print. 3. Student chooses printers that are available in the system. 4. Student specifies the printing properties such as paper size, pages (of the file) to be printed, one-/double-sided, number of copies. 5. Student confirms the request. 6. System responds to the user whether the printing process is successful or not. 7. The printing process is recorded in the printing log.
Alternative Flows	2.1. Student can add or discard any document.
Exceptions	4.1. The system will discard any document that is not in permitted format 4.2. The system will not provide service to student when that student has run out of default pages. 6.2. The system will send notification when there is an error or interrupt while processing the printing request.

3. Use case View printing log

ID and Name	UC-3 View printing log
Created by	Nguyen Tan Bao Le
Date created	28/09/2024
Actor	Student, SPSO
Description	Student can view the printing history for a time period with a summary of the number of printed pages. The SPSO can view the printing history of all or a student for a time period and for all or some printers.
Trigger	Student needs to view their printing history The SPSO needs to manage the students' printing activities

Preconditions	1. Student and the SPSO have been authenticated by the system. 2. The device can be able to communicate to the system
Postconditions	1. Student and the SPSO can view their log clearly. 2. The SPSO can detect any suspicious printing activities.
Normal Flow	1. Student and the SPSO access to the printing history web page. 2. One row in the view represents a printing activity. 3. The system will display the log with the following information: student ID, printer ID, file name, printing start and end time, number of pages for each page size. 4. Students and the SPSO can sort their view based on their role.
Alternative flow	4.1 Students and the SPSO can select a time period when viewing. 4.2. The SPSO can view all students or a student for all printers or a printer.
Exceptions	4.3. Invalid range of time will be notified by the system. 4.4 Viewing non-exist students or printers will be notified by the system.

4. Use case Buy printing pages

ID and Name	UC-4 Buy Printing Pages
Created by	Nguyen Tan Phong, Nguyen Thien Loc
Date created	28/09/2024
Actor	Student, BKPAY
Description	Students are allowed to buy more paper by paying some amount of money through some online payment system like the BKPay system of the university.
Trigger	Student who has run out of default pages
Preconditions	1. Student is authenticated by the system.

	2. Student's device can be able to communicate to the system.
Postconditions	The number of pages for printing of student is updated
Normal Flow	1. Student accesses to the purchasing printing pages web page. 2. Student can choose their payment method. 3. Student chooses a number of pages. 4. The request is sent to BKPay. 5. The system updates the new number of printing pages.
Alternative flow	2.1. Students fill out their information for payment. 5.1. BKPay announces that the transaction is processed successfully.
Exceptions	3.1. The system will notify if the number of pages is less than zero 4.1. The system will reject the request if the number of pages exceeds his/her account (page) balance or there is an error that happened during the process.

3. Task 2: System modeling (2.1, 2.2, 2.3, 2.4)

3.1 Activity diagrams

3.1.1 Authentication services

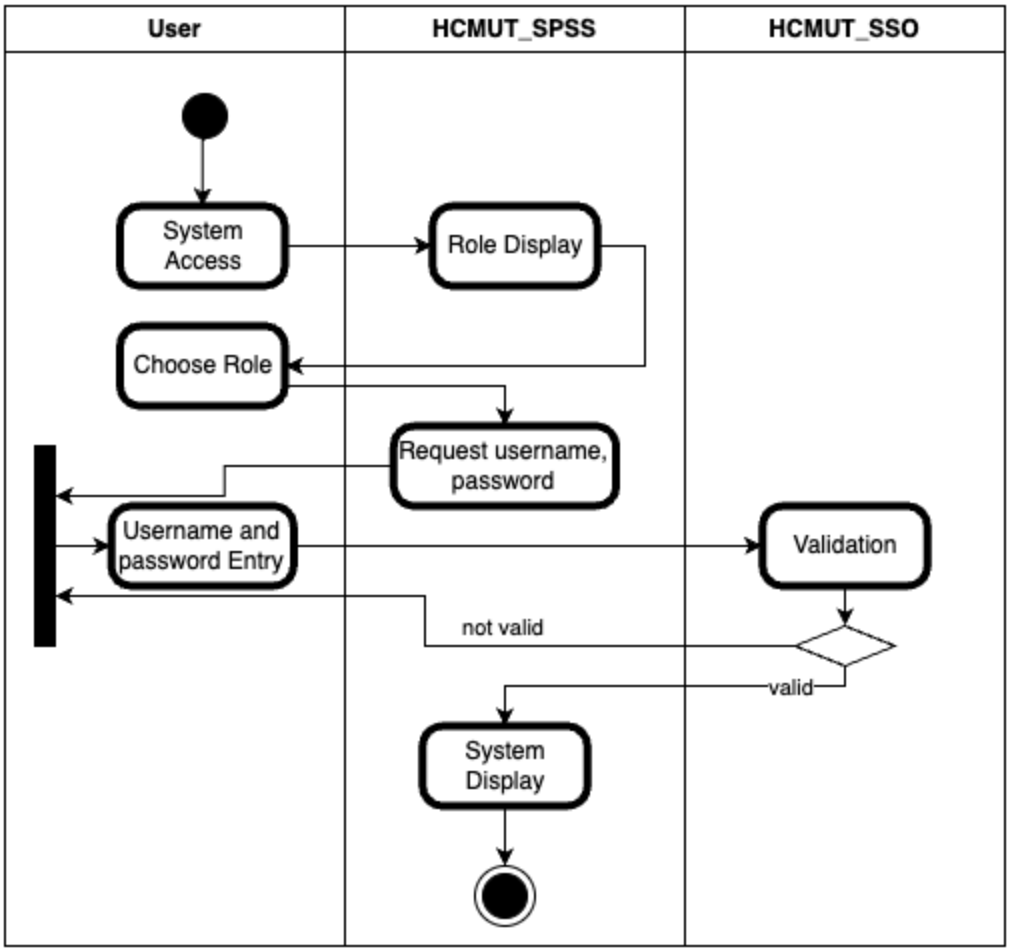


Figure 3: *Activity diagram for Authentication Service*

Description: Users (including students and SPSO system administrators) after accessing service website, will be navigated to the first page which requires choosing a role. After choosing a role, the system will display a login form containing information fields including: account name, password. After the user has entered the information and pressed the submit button, the system will hash the user's password and send the above information to HCMUT_SSO (controller). After HCMUT_SSO receives the information, HCMUT_SSO will first retrieve the user's account and password information based on permissions. Next, HCM_SSO will check the match between hash codes. If there is no match, redirect the user back to the login page and display the status "Incorrect account/password information". If there is a match, navigate the user to the home page corresponding to the user's rights.

- User (customers, SPSO, printers' providers): Perform operations on the interface to log in.
- HCMUT_SSO: Implementing the Authentication function (Single Sign-On).

3.1.2 Print a document

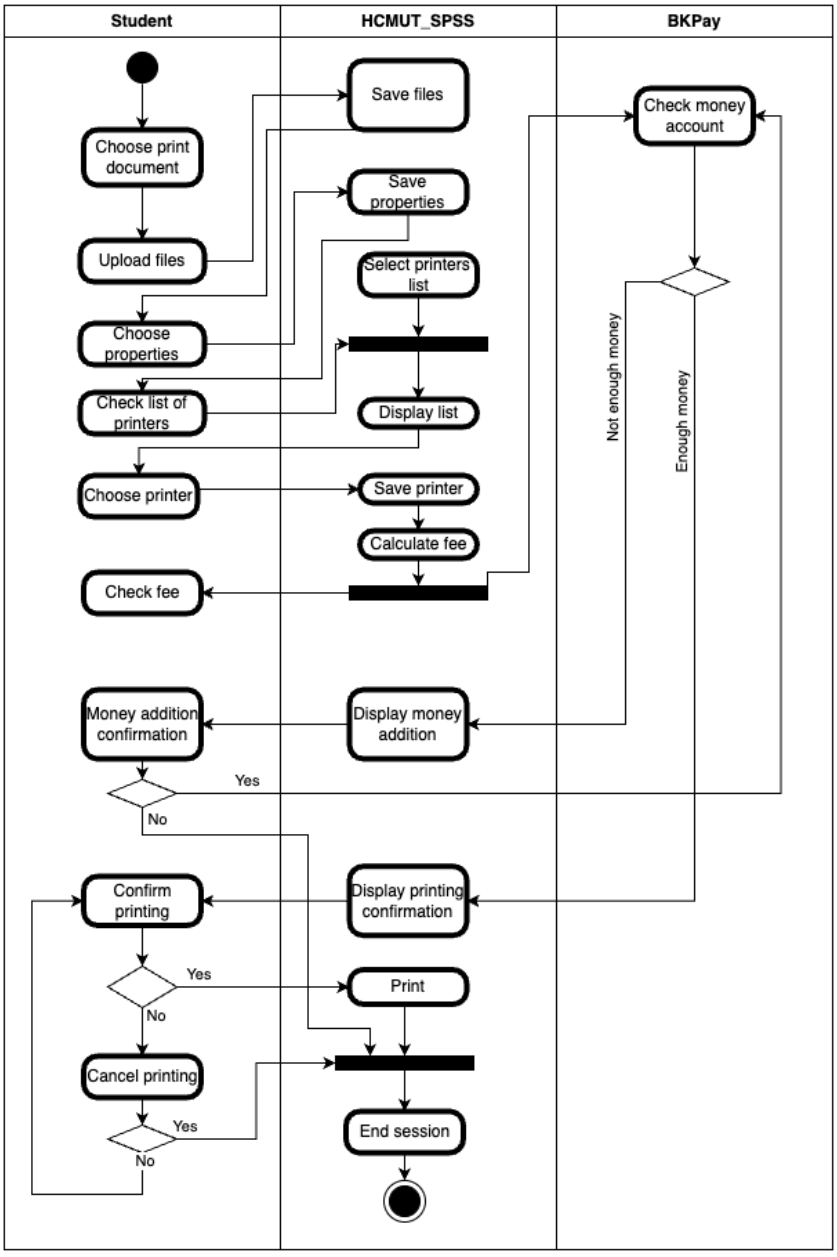


Figure 4: *Activity diagram for Print a document*

Description: Students click the "Print Document" button on the home page interface. Students upload files into the system and the system saves files before continuing to display the interface properties in. User's custom configuration properties and press the button in to save them on the system. Then, the system will access the database list of machines that are in an empty state, if any, the system will display this list on the interface. When the system displays the list of machines in the interface, students select a machine in any term, the system displays the fee display interface. The system processes the original in the system, if

the number of pages exceeds the number of pages in the account, the system will display the message "Missing pages" students choose to buy more pages or return to the home page. Otherwise, if there are enough pages, the system proceeds normally.

- User (customers, SPSO, printers' providers): Perform operations on the interface to print the document.
- HCMUT_SPSS: Process the document printing function according to the operations from students and proceed to print the document.
- BKPAY: Process the request for checking money amount.

3.1.3 Manage service configuration

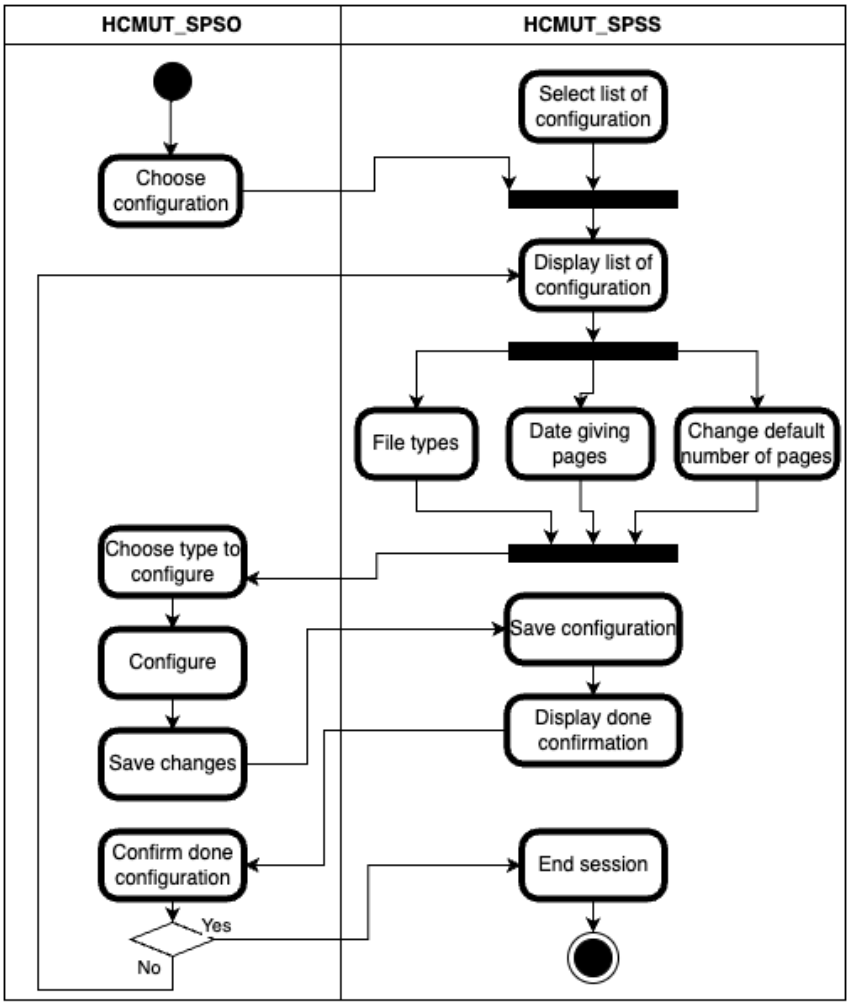


Figure 5: *Activity diagram for Manage service configuration*

Description: SPSO clicks the configuration button on the interface. From the database, the system loads a list of configuration before displaying it to SPSO. In total, there are three

types of configuration including file types, date giving pages to the students, and option to change the default number of pages. After picking a type, SPSO configures and saves changes to the system. Then, "done configuration" confirmation is displayed for users to click on. If the users confirm "yes", the session will end. Otherwise, the users continue to configure the system.

- HCMUT_SPSO: Perform operations on the interface to configure the system.
- HCMUT_SPSS: Process the configuration from the user interface and save on the database.

3.1.4 Manage printers

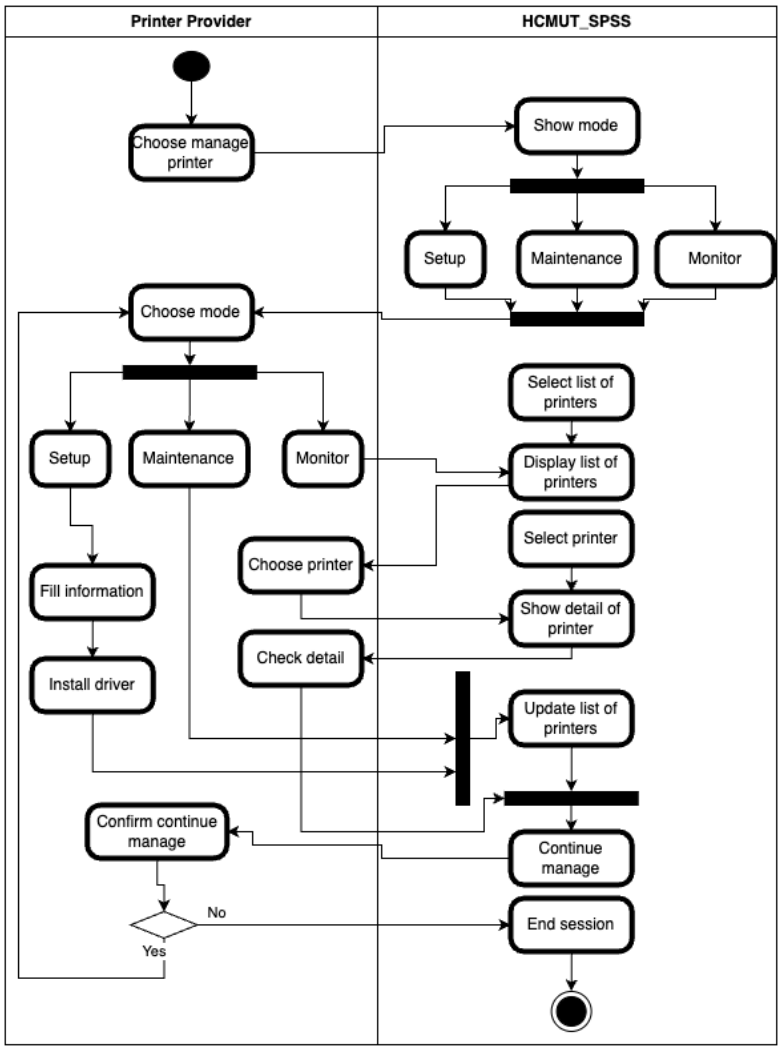


Figure 6: *Activity diagram for Manage printers*

Description: Printer provider clicks on the Manage printer button on the interface. The system redirects users to the Manage printer view. The system shows modes of management

for the printer provider to choose. There are three cases including Setup, Maintenance, Monitor.

- If users choose Setup, the system will create a form for users to fill in the information of the new printer. Then, the system will show a port for users to install the driver of the printer. At the end of this case, the system updates the list of printers.
- If users choose Maintenance, the system will show different options to maintain the printers before updating the status of printer and the list of printers.
- If users choose Monitor, the system will load from the database list of printers and show them to the user. Here, users can choose the printer. From the database, the system calls the information of that printer and shows it to users for checking detail.

At the end of each case, the users are asked if they want to continue managing the printers. If the answer is yes, the system will redirect them to the initial step. If not, the session will be ended.

- Printer provider: Perform operations on the interface to manage printers.
- HCMUT_SPSS: Process the request from the users and show the results.

3.2 Sequence diagrams

3.2.1 Login Service

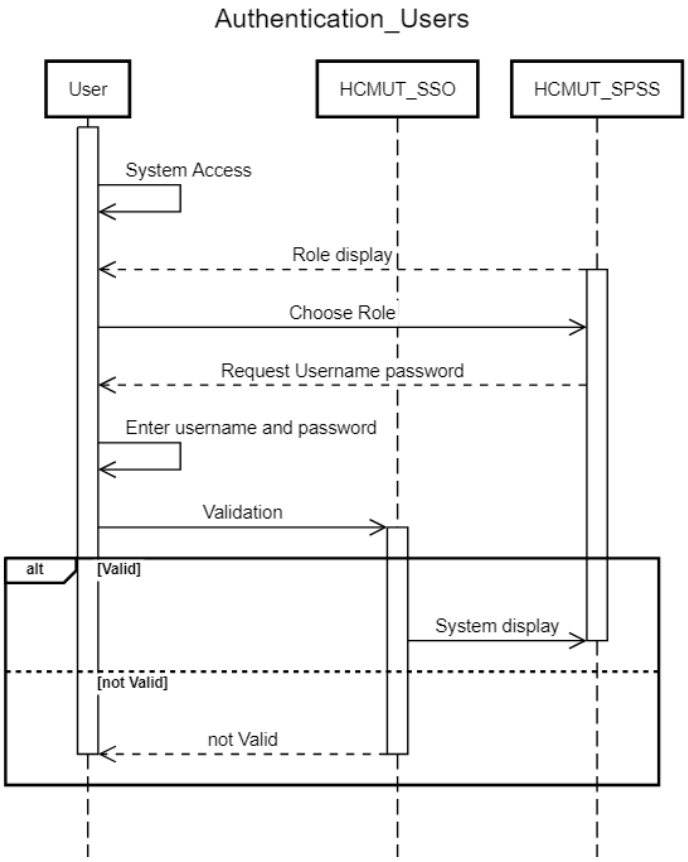


Figure 7: *Sequence diagram for Login Service*

The login activity involves the user and two key objects, following a simplified MVC-like structure:

- **User**: The primary actor who interacts with the system to log in.
- **HCMUT_SPSS**: The login interface where the user inputs their credentials .
- **HCMUT_SSO**: The main component that handles login actions initiated from the LoginForm. It validates user credentials.

3.2.2 Print a Document

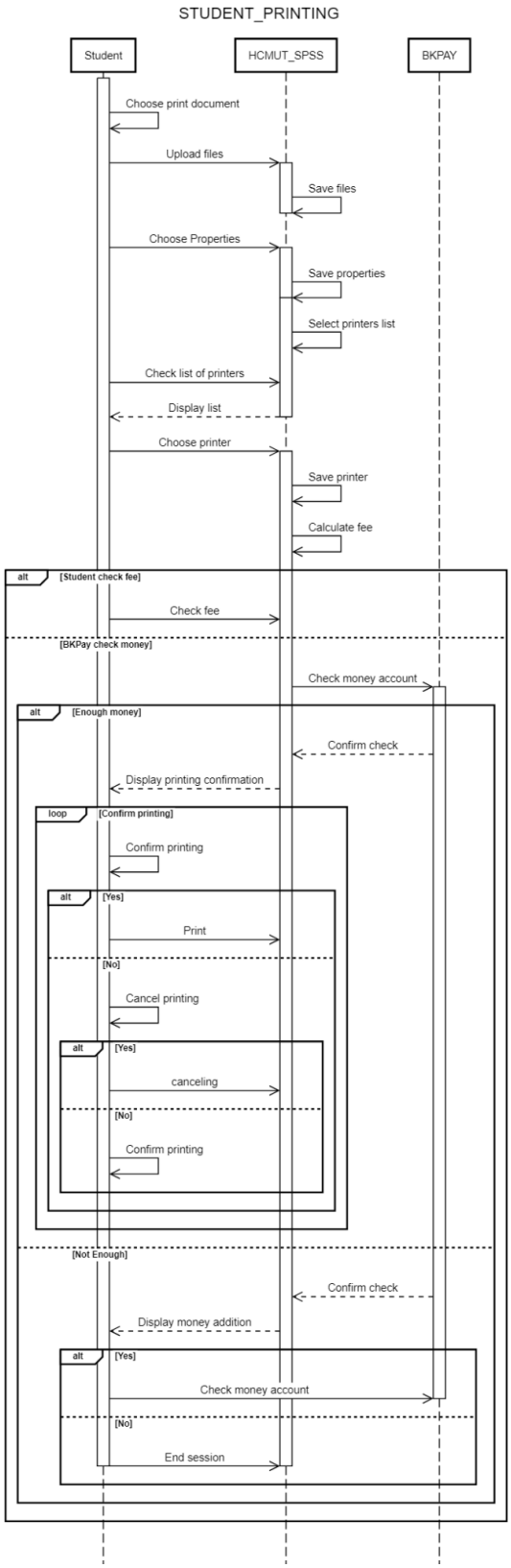


Figure 8: *Sequence diagram for Print a Document*

Description: The document printing activity involves the actor Student and related objects according to the MVC model.

- **User**: The person interacting with HCMUT_SPSS to perform document printing actions.
- **HCMUT_SPSS**: The component responsible for processing user information and performing printing tasks.
- **BKPAY**: The component that handles payment processing and checks the account balance.

3.2.3 Manage service configuration

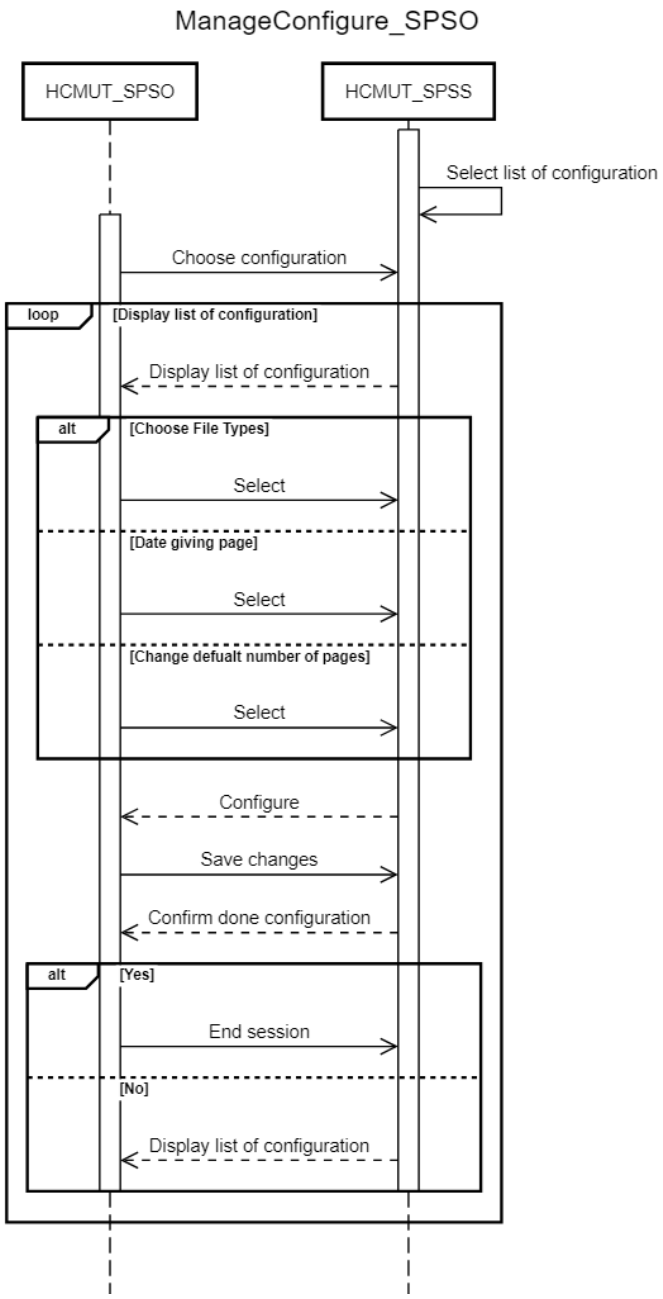


Figure 9: *Sequence diagram for Manage service configuration*

Description: The system settings change activity involves the actors **HCMUT_SPSO** and **HCMUT_SPSS**, following the MVC model:

- **HCMUT_SPSO**: Responsible for interacting and configuring the printer settings.
- **HCMUT_SPSS**: Receives information from **HCMUT_SPSO** and executes commands as requested: changes the amount of printed paper, changes the date of paper issuance, changes the type of file used.

3.2.4 Manage the Printer

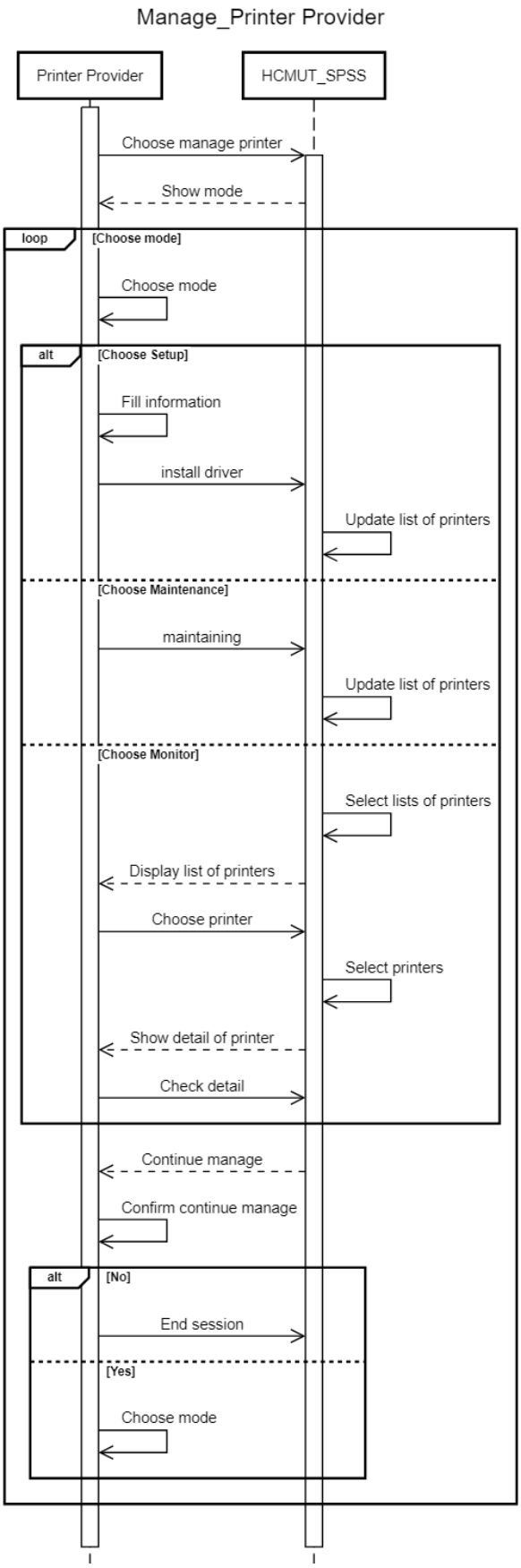

Manage_Printer Provider
Printer Provider
HCMUT_SPSS
Choose manage printer
Show mode
loop
[Choose mode]
Choose mode
alt
[Choose Setup]
Fill information
install driver
Update list of printers
[Choose Maintenance]
maintaining
Update list of printers
[Choose Monitor]
Select lists of printers
Display list of printers
Choose printer
Select printers
Show detail of printer
Check detail
Continue manage
Confirm continue manage
alt
[No]
End session
[Yes]
Choose mode

Figure 10: *Sequence diagram for Manage the Printer*

Description: The printer management activity between the Printer Provider and HCMUT_SPSS follows the MVC model:

- **Printer Provider:** Plays a role in setting up printers, including selecting and installing drivers, maintaining, or monitoring printers.
- **HCMUT_SPSS:** Receives information and updates the list of printers (if necessary).

3.3 Class diagrams

3.3.1 Login Service

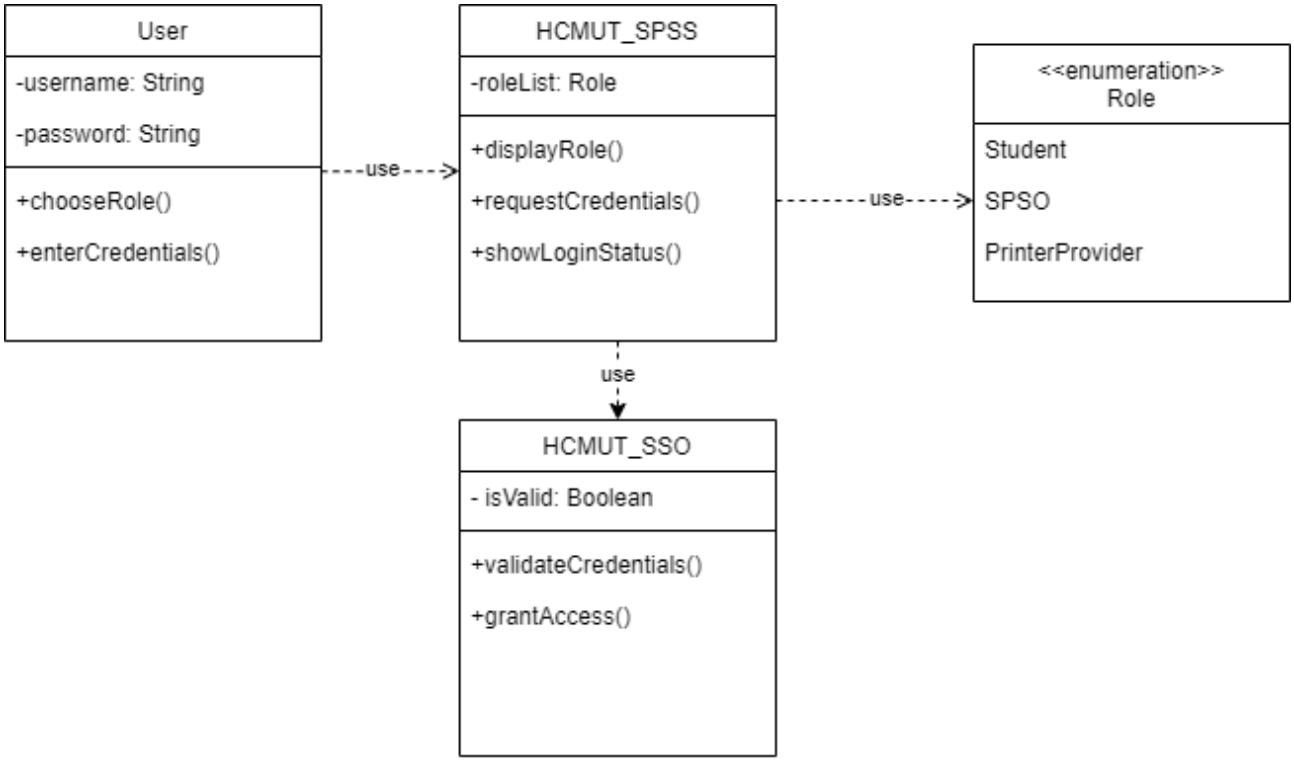


Figure 11: *Class diagram for Login Service*

Description:

1. User
    - chooseRole(): The user selects their role
    - enterCredentials(): The user enters their username and password
2. HCMUT_SPSS
    - displayRole(): Displays the list of available roles for the user
    - requestCredentials(): Require the User to enter their Username and Password
    - showLoginStatus(): Indicates whether the user has logged in successfully or not
3. HCMUT_SSO
    - validateCredentials(): Validates the user's username and password
    - grantAccess(): Grants access to the user if the credentials are valid

3.3.2 Student print a document

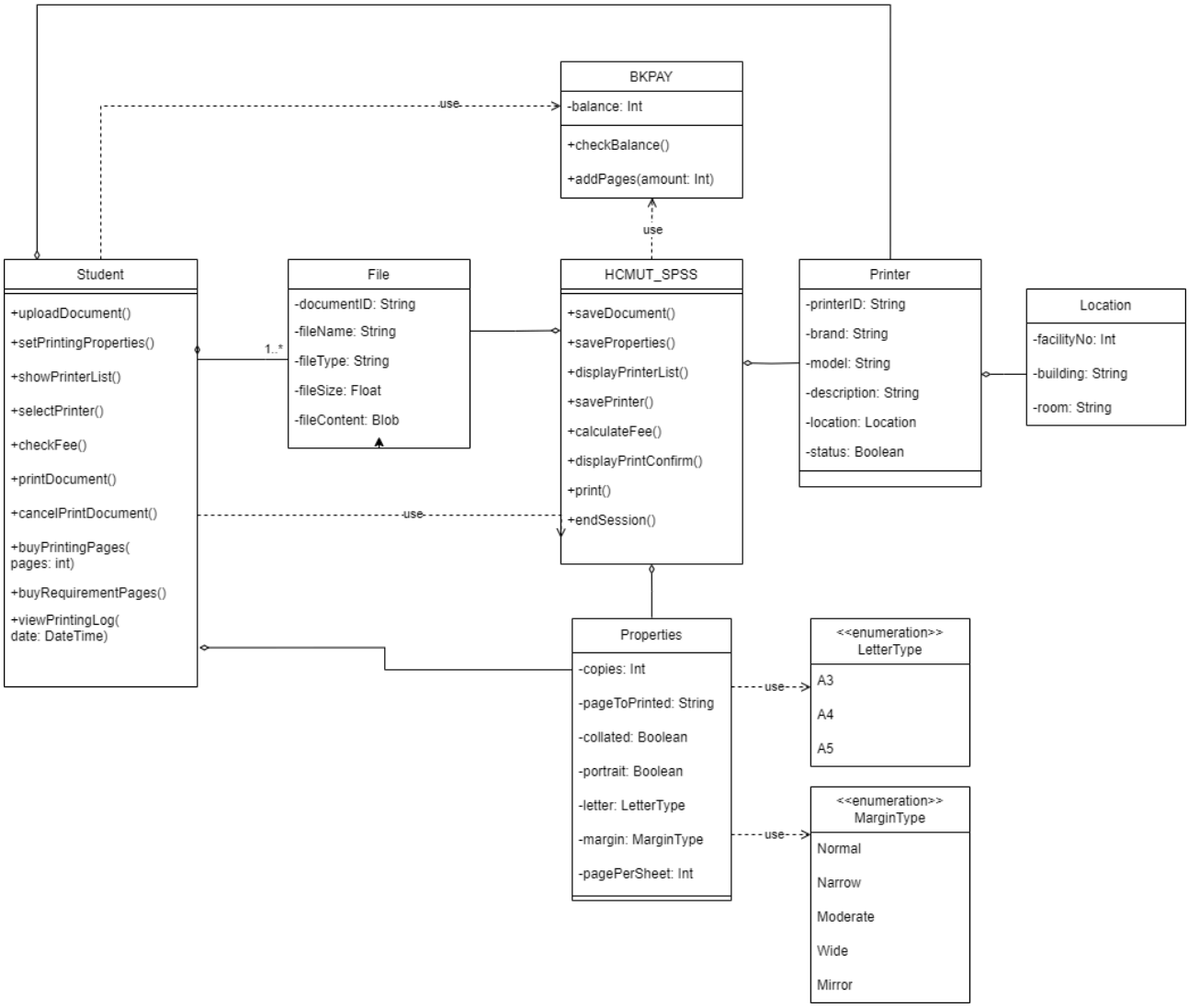


Figure 12: *Class diagram for Print a document*

Description:

1. Student:
    - updateDocument(): The student uploads their document
    - setPrintingProperties(): The student sets the printing properties
    - showPrinterList(): The student requests the list of available printers
    - selectPrinter(): The student selects a printer
    - checkFee(): The student checks the fee to print the document
    - printDocument(): The student initiates the printing of the document
    - cancelPrintDocument(): The student cancels the document print
    - buyPrintingPages(pages: int): The student purchases a specific number of pages for printing
    - buyRequirementPages(): The student purchases any additional pages needed for printing

- viewPrintingLog(date: DateTime): The student views their printing history for a specified date

2. HCMUT_SPSS:
   - saveDocument(): Save the upload document
   - saveProperties(): Save the Printing Properties
   - displayPrinterList(): Display the printer list
   - savePrinter(): Save the select printer
   - calculateFee(): Calculate the fee to print the document
   - displayPrintConfirm(): Display the confirmation to print the document
   - print(): Print the document
   - endSession(): End this session
3. BKPAY:
   - checkBalance(): Check the balance of the Student
   - addPages(amount: int): Add the number of pages into the balance

3.3.3 Manage service configuration

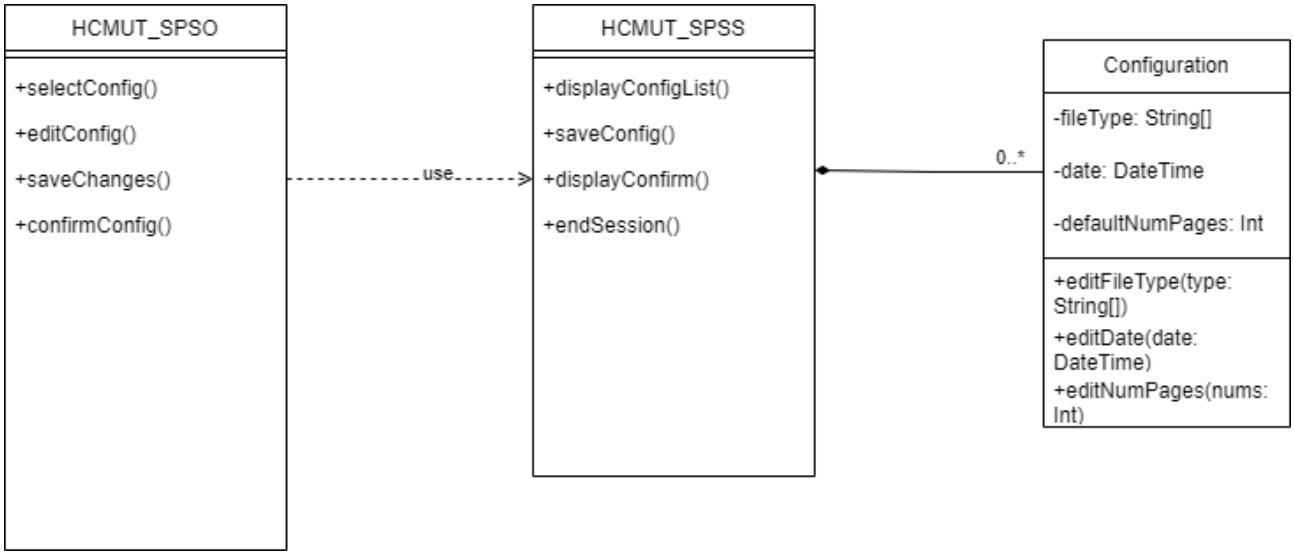


Figure 13: *Class diagram for Manage service configuration*

Description:

1. HCMUT_SPSO:
   - selectConfig(): Selects a configuration from the list
   - editConfig(): Edit s the selected configuration
   - saveChanges(): SPSO save changes made to the configuration
   - confirmConfig(): SPSO confirms that the configuration should be saved
2. HCMUT_SPSS:
   - diplayConfigList(): Displays the list of available configurations
   - saveConfig(): Saves the current configuration

- displayConfirm(): Prompts the SPSO to confirm the configuration save
- endSession(): End the current session

3. Configuration:
    - editFileType(type: String[]): Modifies the acceptable file types that can be uploaded
    - editDate(date: DateTime): Updates the date for paper refills
    - editNumPages(nums: Int): Sets the maximum number of pages allowed per document

3.3.4 Manage the Printer

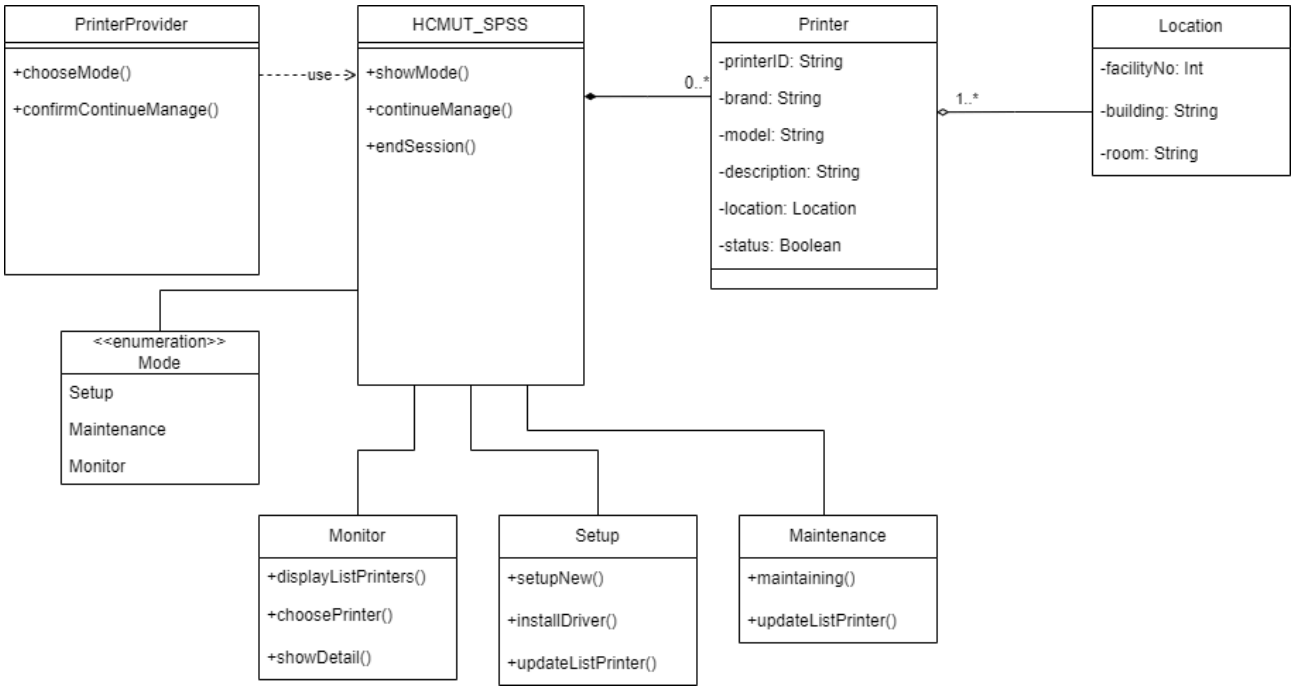


Figure 14: *Class diagram for Manage the Printer*

Description:

1. PrinterProvider:
    - chooseMode(): Selects the mode for management
    - confirmContinueManage(): Confirms the continuation of management
2. HCMUT_SPSS:
    - showMode(): Displays all available management modes
    - continueManage(): Continues management tasks
    - endSession(): Ends the current session
3. Monitor:
    - displayListPrinters(): Display a list of all printer
    - choosePrinter(): Selects a printer to monitor

- showDetail(): Displays details of the chosen printer

4. Setup:
    - setNew(): Sets up a new printer
    - installDriver(): Installs the driver for the new printer.
    - updateListPrinter(): Adds the new printer to the list of printers
5. Maintenance:
    - maintaining(): Displays maintenance options for the printers
    - updateListPrinter(): Updates the status of printers in the list

3.4 MVP

3.4.1 The Homepage and the login page

1. Wireframe:

When accessing the software. The viewers will see the homepage and the login page first.

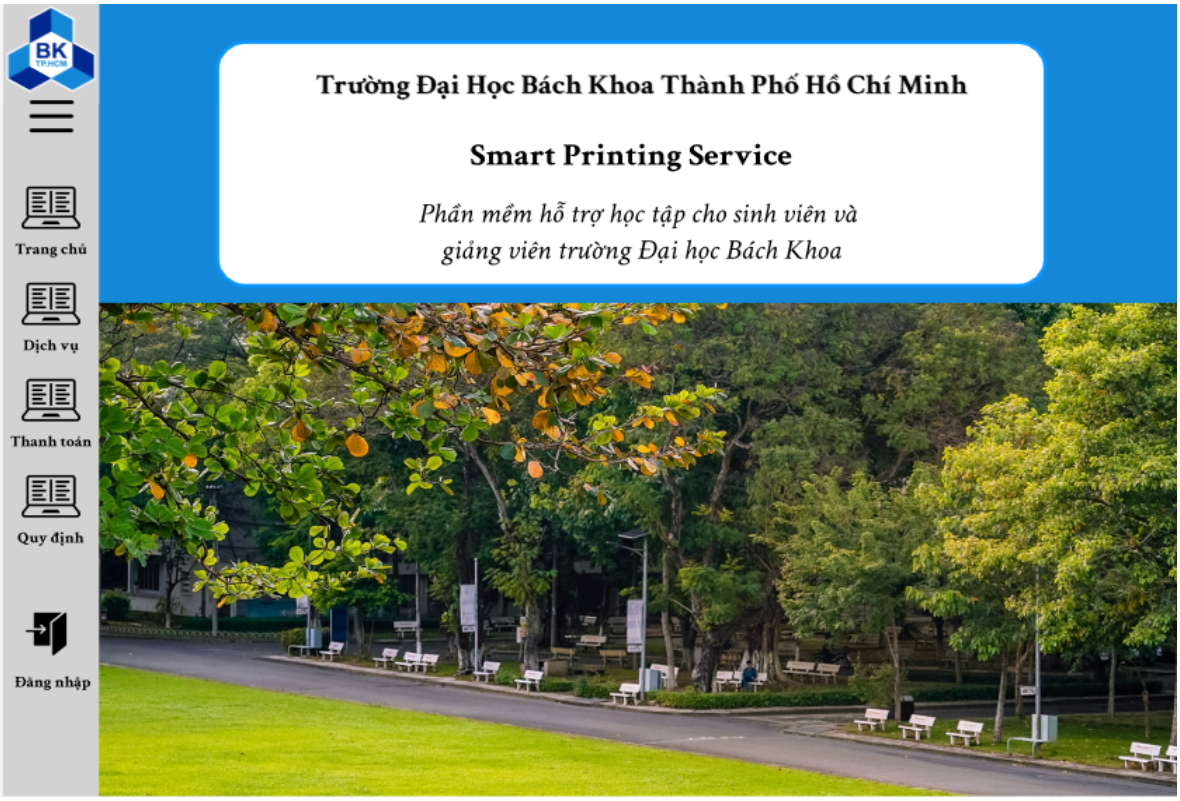


Figure 15: *The homepage interface*

Figure 16: *The login interface*

2. Table description:

	Components	Actions	Description
1	Homepage button	Click	The webpage will return to the homepage as you can see in the first figure.
2	Service button	Click	The webpage will switch to the page containing the information about this smart printing software.
3	Payment button	Click	The webpage will switch to the page containing the information about the payment service for this software.
4	Rule button	Click	The webpage will switch to the page containing the information about the web page containing the rule for the user when using this software
5	Login for the user	Click and put in the	After putting the correct password for the user

		password	account. The webpage will switch to the user interface to use the service.
6	Login for the manager	Click and put in the password	After putting the correct password for the manager account. The webpage will switch to the manager interface.
7	Login for the printer company	Click and put in the password	After putting the correct password for the printer company account. The webpage will switch to the printer company interface.

Table 1: Table showing the detail application for the homepage and login

3. More details on the components:

When the user login successfully, the webpage switches to the user interface and has a lot more options to use. The user should have a look at the rules page and then use the software. The more detailed button and application of the user will be discussed in the next interface sections.

Figure 17: *The user interface homepage*

Similar to the view of the homepage of the printer company and manager interface. The more details will be discussed in the next section.

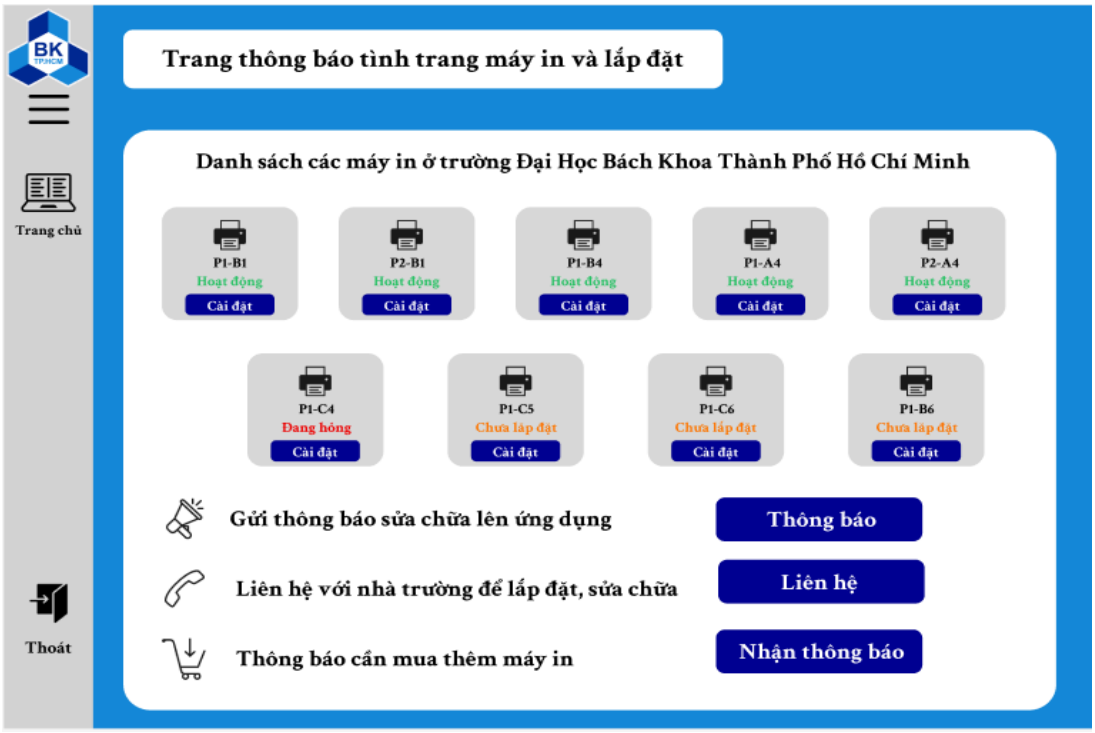


Figure 18: *The printer company interface*

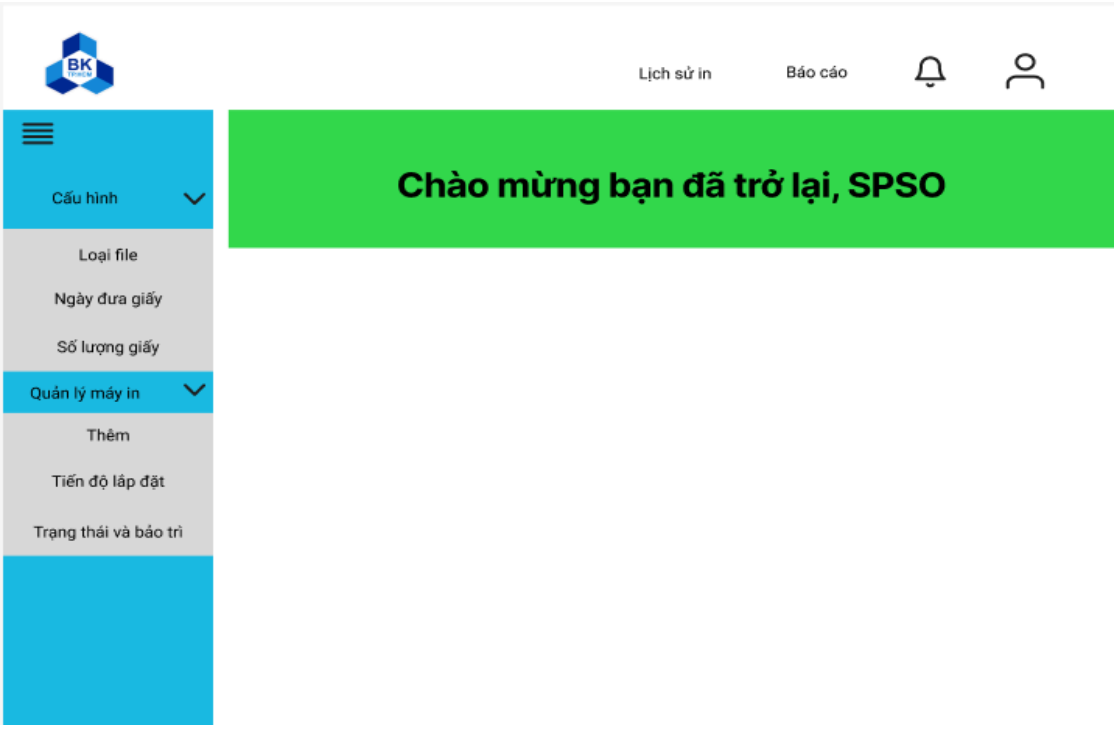


Figure 19: *The manager interface*

3.4.2 The User interface

1. Wireframe:

The user interface contains all kinds of services and applications to help the user using the printer more efficiently.

Figure 20: *The homepage interface of users*

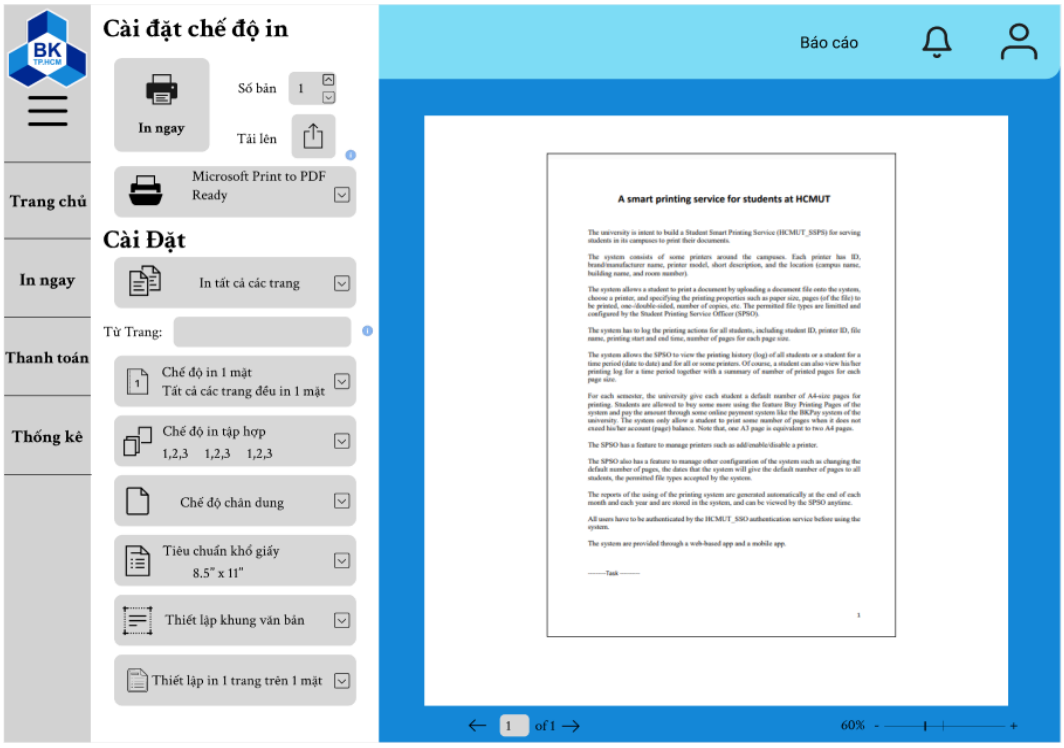


Figure 21: *The printing options of users*

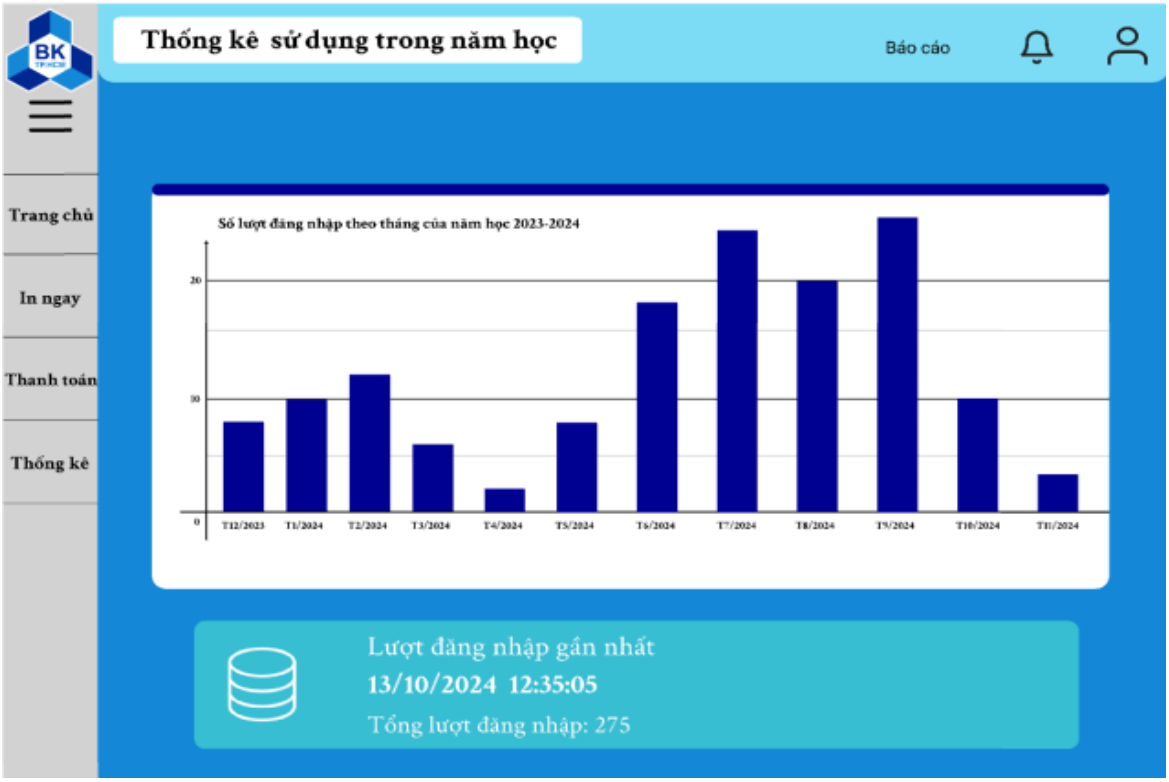


Figure 22: The interface of statistical analysis

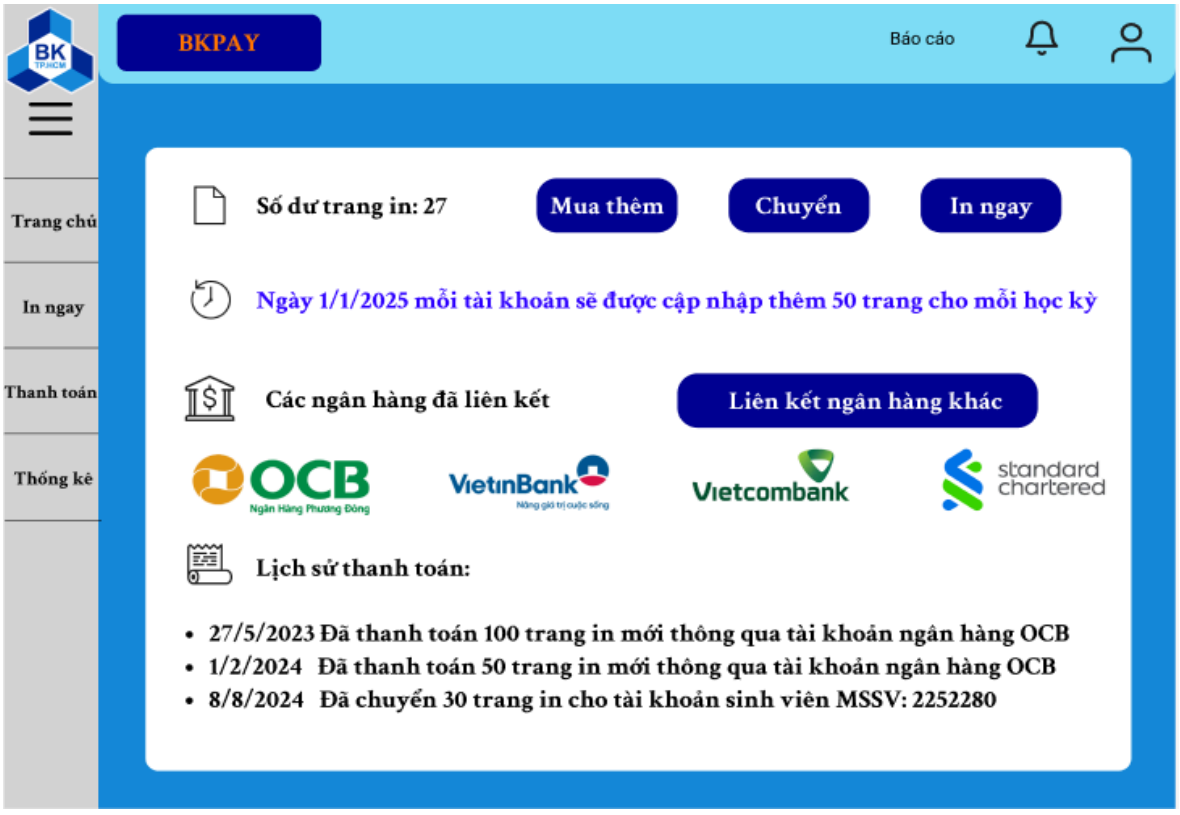


Figure 23: The payment option for the user

2. Table description:

	Components	Actions	Description
1	The human button	Click	That is the logout button. The webpage will turn back to the login interface.
2	Bell button	Click	It will show any announcement sent to your account.
3	Report button	Click	It will switch to the report interface to send any complaint about the service.
4	User homepage button	Click	It will switch pages to the user interface.
5	Printing button	Click	It will switch to the printing interface for the user.
6	Payment Button	Click	It will switch to the payment interface for the user.
7	Statistic button	Click	Description
8	The setting printer option button	Click and modify	Clicking and then choosing the best option for the page.
9	Print now button	Click	It will activate the printer to print out the
10	Upload button	Click and choose the file	Click that button and choose the file that the printer will print out for you.
11	Size bar	Drag the stick	Modify the view of the page in the interface.
12	The turn page button	Click	Turn to the next page for the preview.
13	The bar chart showing the login	View	Showing the number of times login per month.
14	The link bank button	Click and choose	Clicking and choosing the bank to link to your account payment.
15	The buy more button	Click	Click when you want to buy more papers.
16	The transfer pages	Click and	Clicking and choosing the other account you want to

	button	choose	transfer the page to.
17	The print now button	Click	It will switch to the printing option interface.
18	The history payment	View	Showing the history payment of the account.

Table 2: Table showing the detail application for the user interface

3. More details on the components:

The best time to log out when finished to protect account security, especially on shared devices. Could provide session duration and warn of unsaved changes before logging out.

The report function is useful for submitting issues with print quality, billing questions, or general feedback. Certain reports may be resolved faster if categorized (e.g., "Technical Issue," "Billing Issue").

The statistical analysis area provides an overview of your account activity (e.g., number of prints, frequency of use). You may also find trends that help manage printing budgets effectively.

Offers a quick view of monthly login frequency, which can be useful for security audits or tracking account access trends.

Payment History Panel shows a record of all transactions, including date, amount, and transaction type. Exporting history can help with budget reviews or reimbursement processes.

For the transfer page button. Handy for team accounts, allowing you to share print credits with colleagues. Typically requires confirmation to prevent accidental transfers.

3.4.3 The Printer company interface

1. Wireframe:

The printer company interface contains only 1 interface. To keep the interface not too difficult for the company to use. We keep all things simple as much as possible

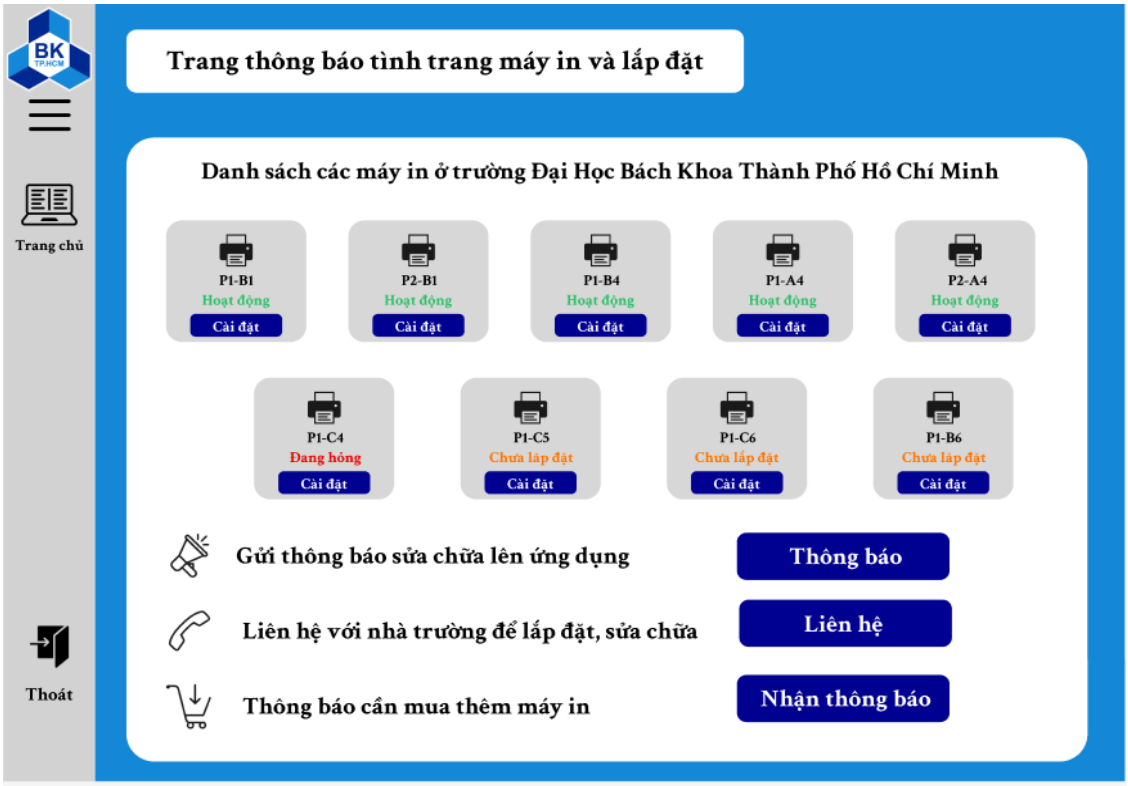


Figure 24: The printer company interface

2. Table description:

	Components	Actions	Description
1	Logout button	Click	That is the logout button. The webpage will turn back to the login interface.
2	Homepage button	Click	It will return to the printer company interface.
3	Edit printer button	Click	Make some modifications for the printer or install the new one.
4	Announce button	Click	Announce to the user that you will make some physical fixing or changing the printer at some locations.
5	Message button	Click	Send a message to the manager.
6	Check announce button	Click	Checking if there are any announcements for the company.

Table 3: Table showing the detail application for the printer company

3. More details on the components:

Logging out helps protect your account, especially on shared or public devices. Some systems may auto-logout after a period of inactivity to prevent unauthorized access. Before logging out, it's recommended to save any unsaved work or settings to avoid data loss.

The Edit button allows you to modify printer settings or install a new printer if you have compatible hardware. It might include settings for network configuration, print quality adjustments, or paper size/type. It's useful for customizing your setup or ensuring new printers are recognized by the system.

Sends an announcement to notify users about any physical maintenance or replacements planned for specific printer locations. This keeps users informed of potential downtimes or disruptions, allowing them to plan ahead for printing needs.

The message button feature enables direct communication with the manager, which is helpful for addressing urgent requests, seeking approvals, or discussing specific printing requirements. Messages sent through this button may be prioritized in the manager's inbox.

The check announcement button displays any new announcements from the company, such as scheduled maintenance, policy changes, or updates to printing services. Keeping up with these announcements can help you avoid inconvenience and stay informed about changes in service availability or printer locations.

3.4.4 The Manager interface

1. Wireframe

The manager interface provides SPSO services for managing system configuration and printers in campuses.

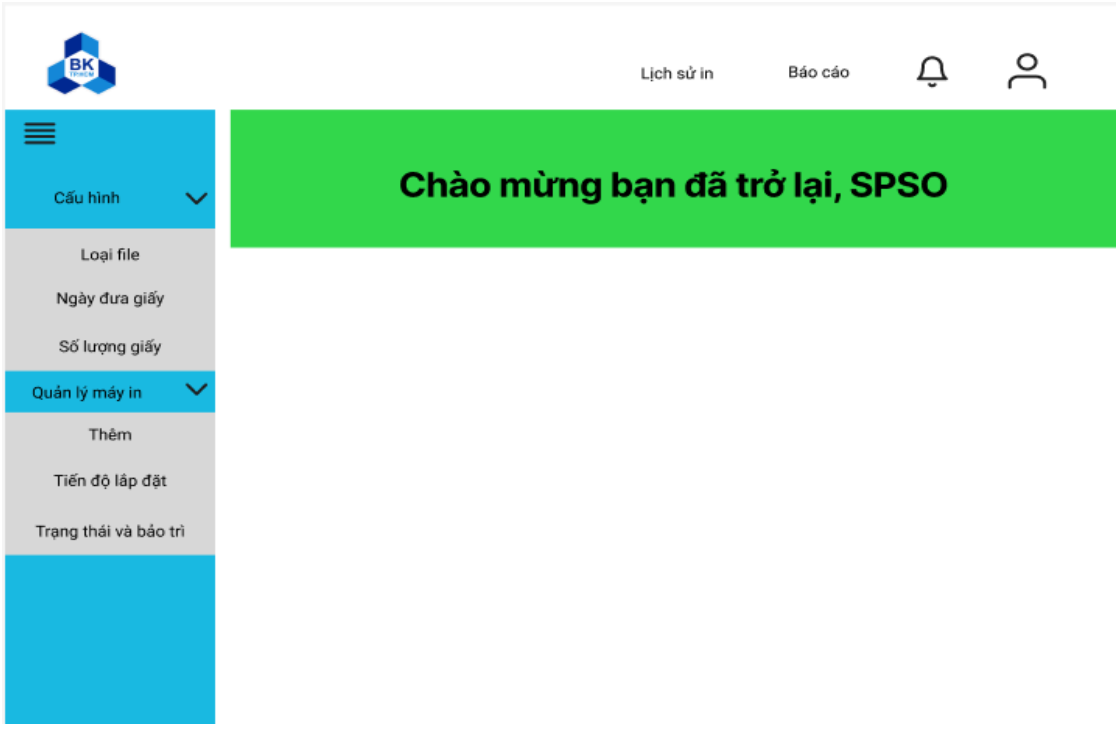


Figure 25: The homepage interface of the SPSO

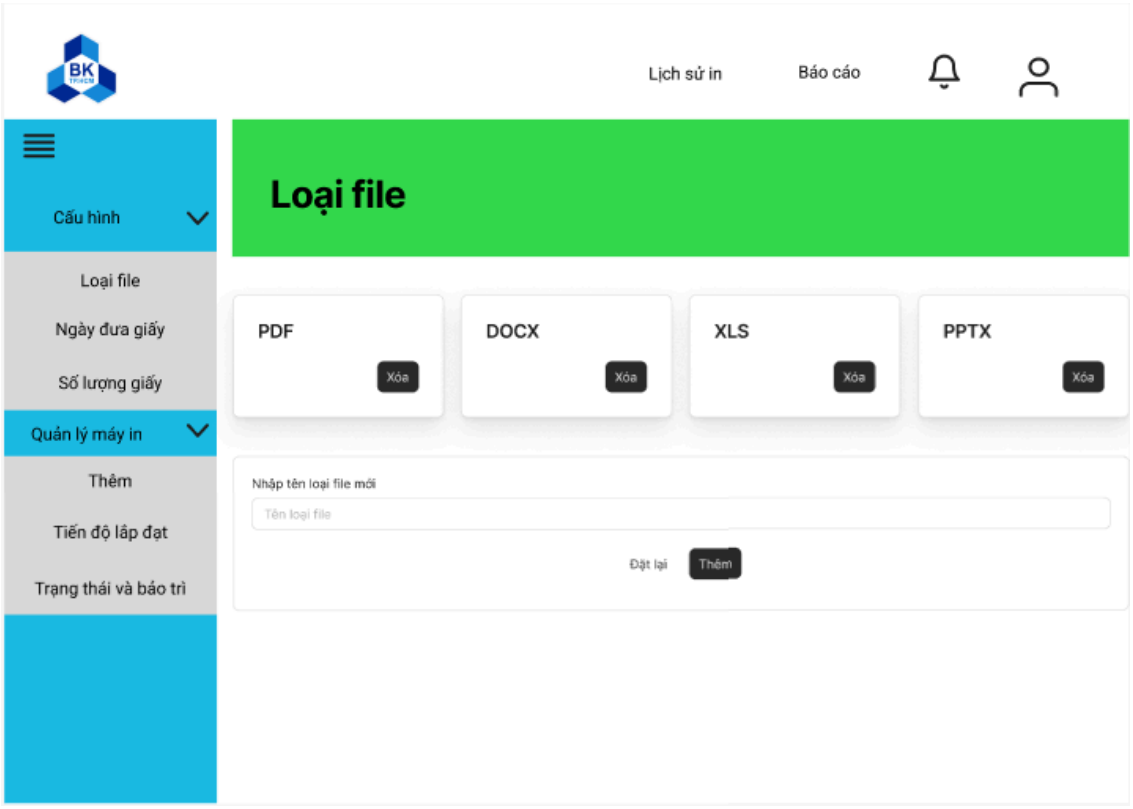


Figure 26: The interface of managing file type

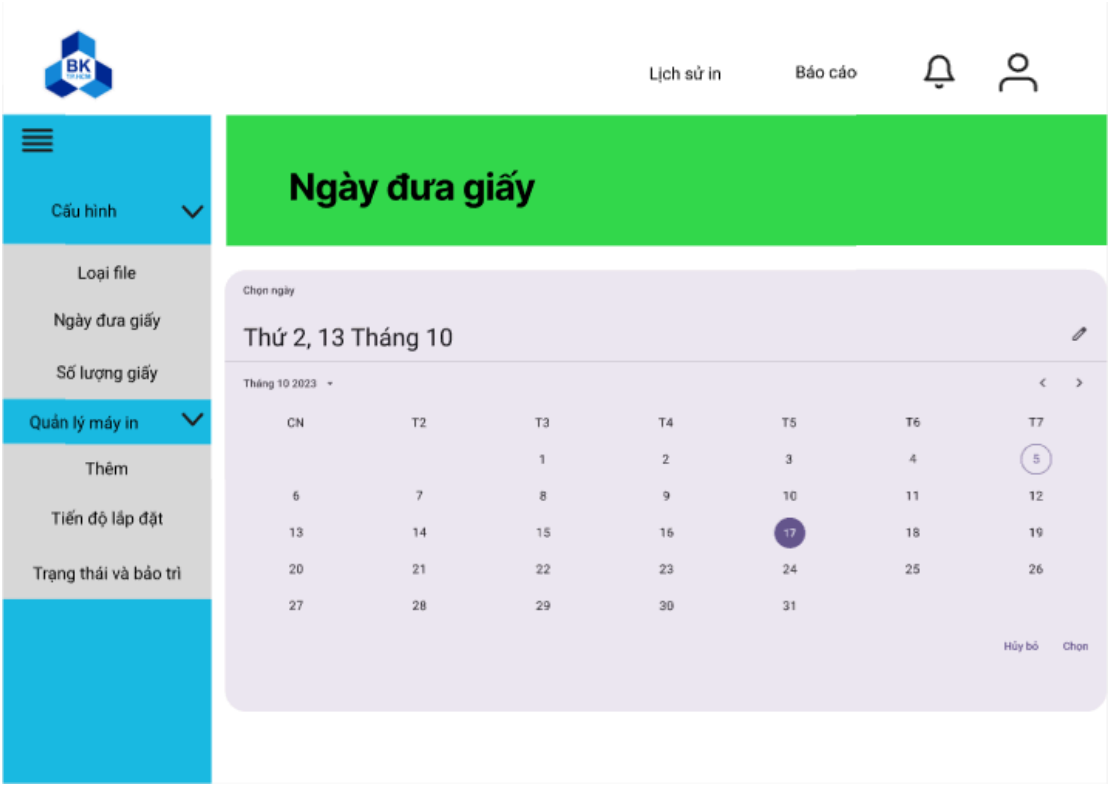


Figure 27: The interface of managing date giving default papers

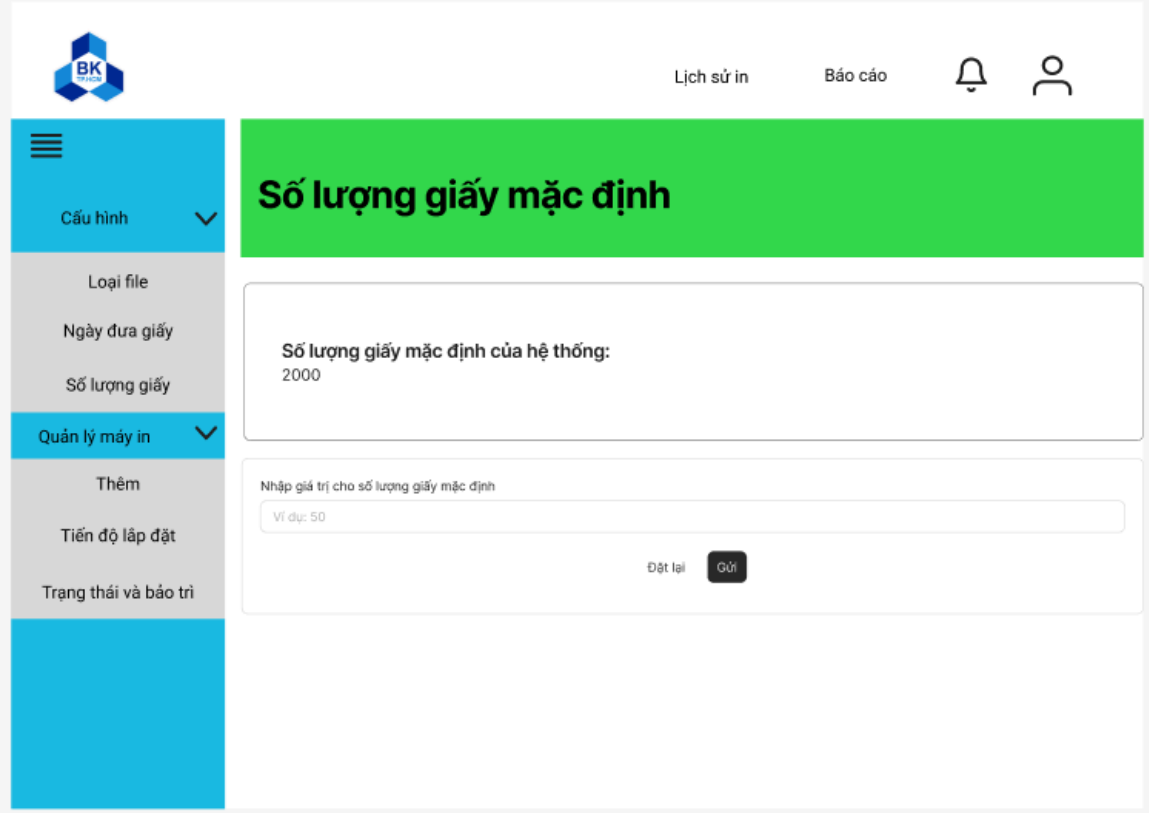


Figure 28: The interface of managing number of default pages giving to students

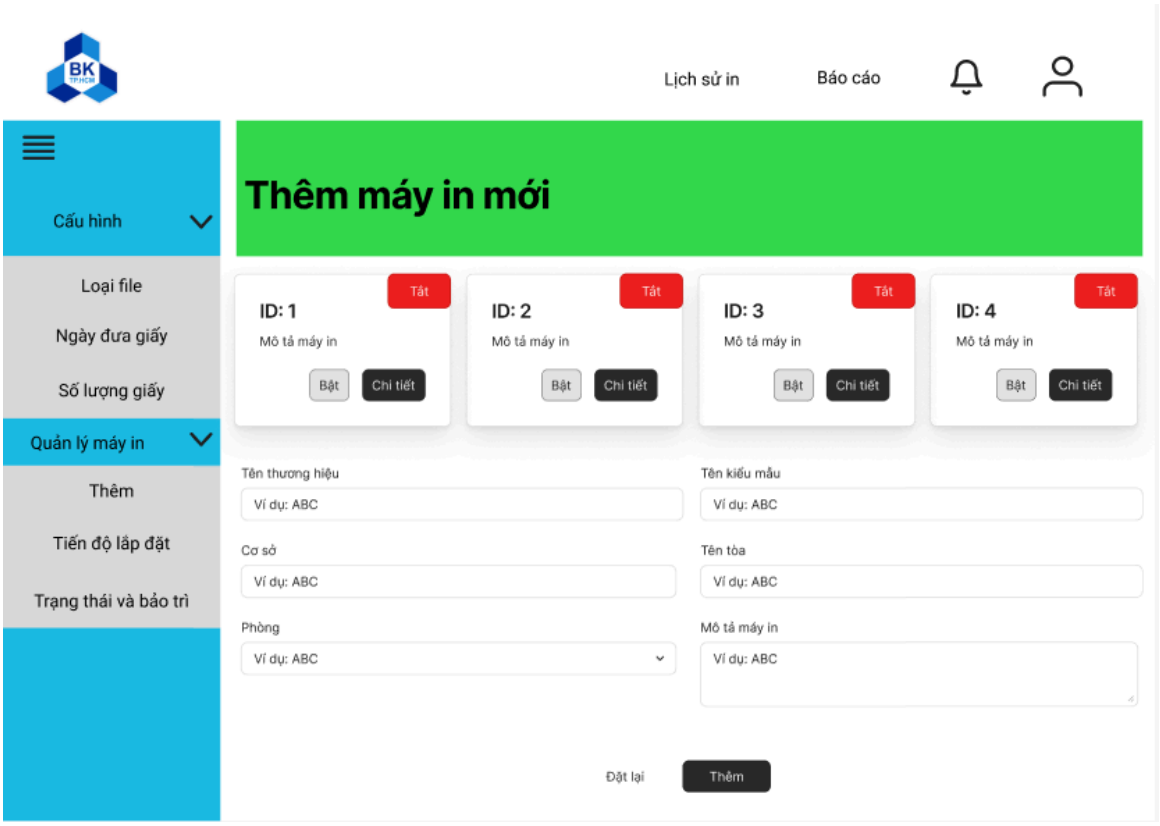


Figure 29: The adding, viewing and disabling printers option for SPSO

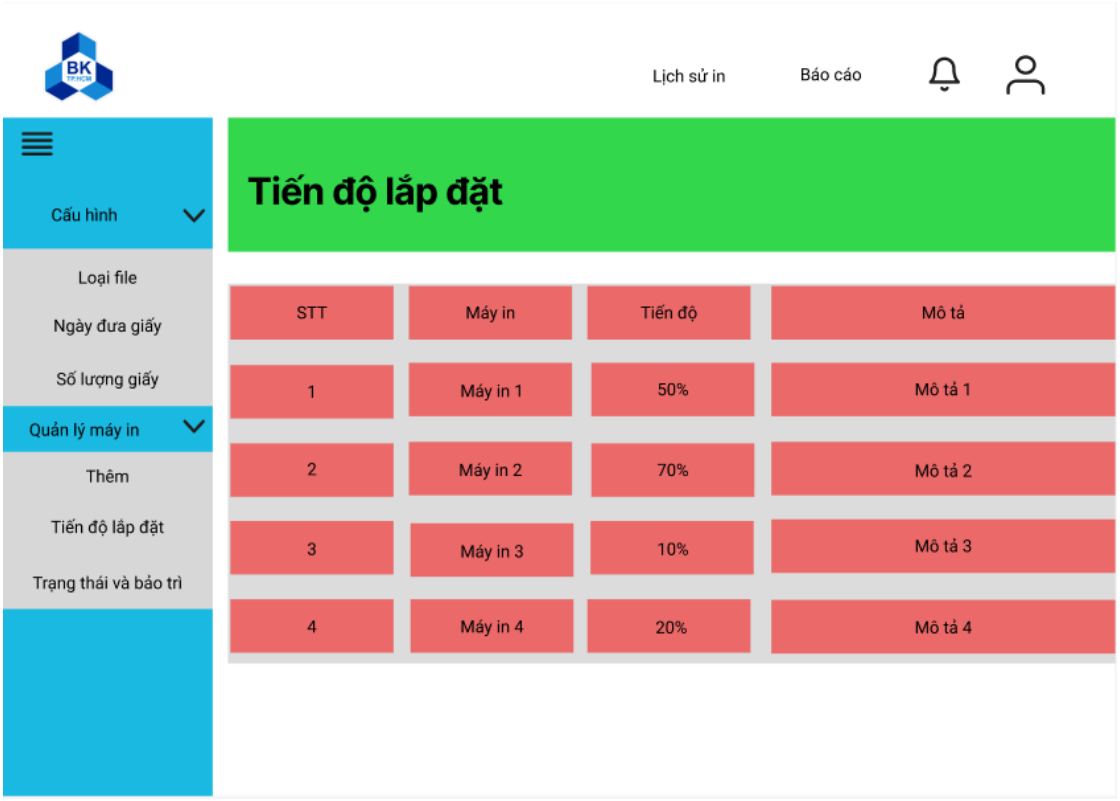


Figure 30: The interface of showing setup progresses

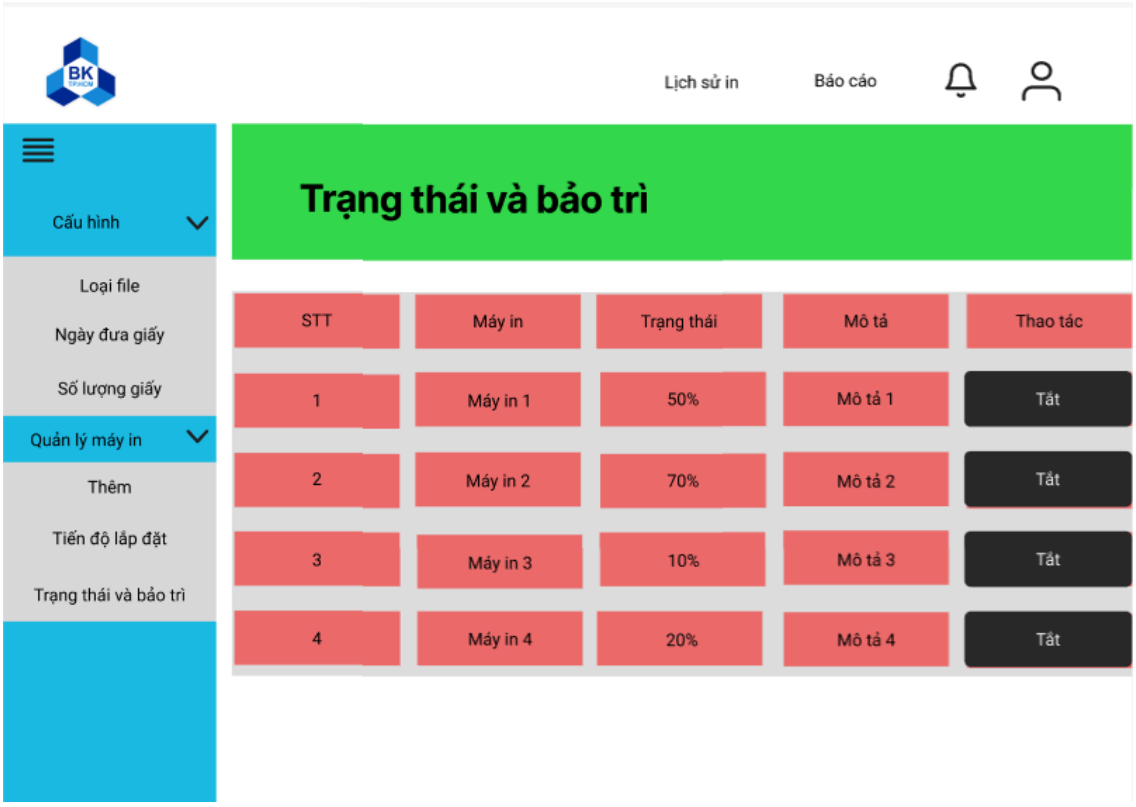


Figure 31: The managing printers' status for maintenance option for SPSO

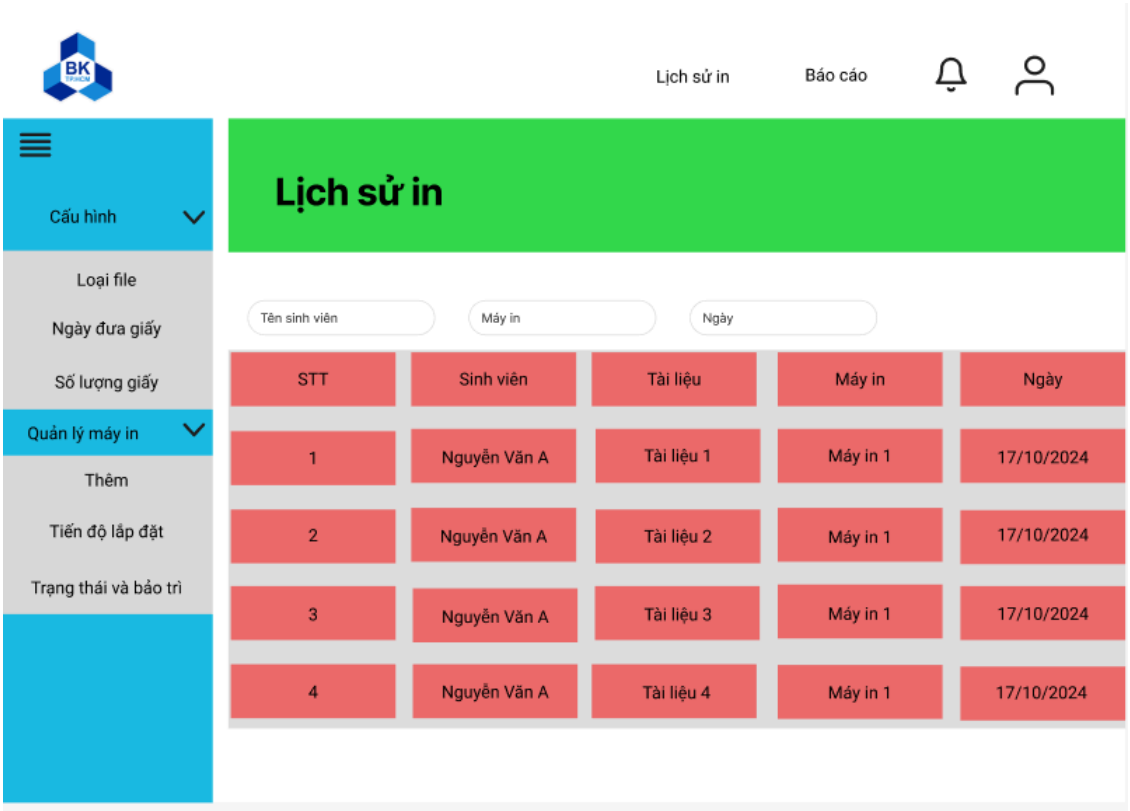


Figure 32: The viewing printing history option for SPSO

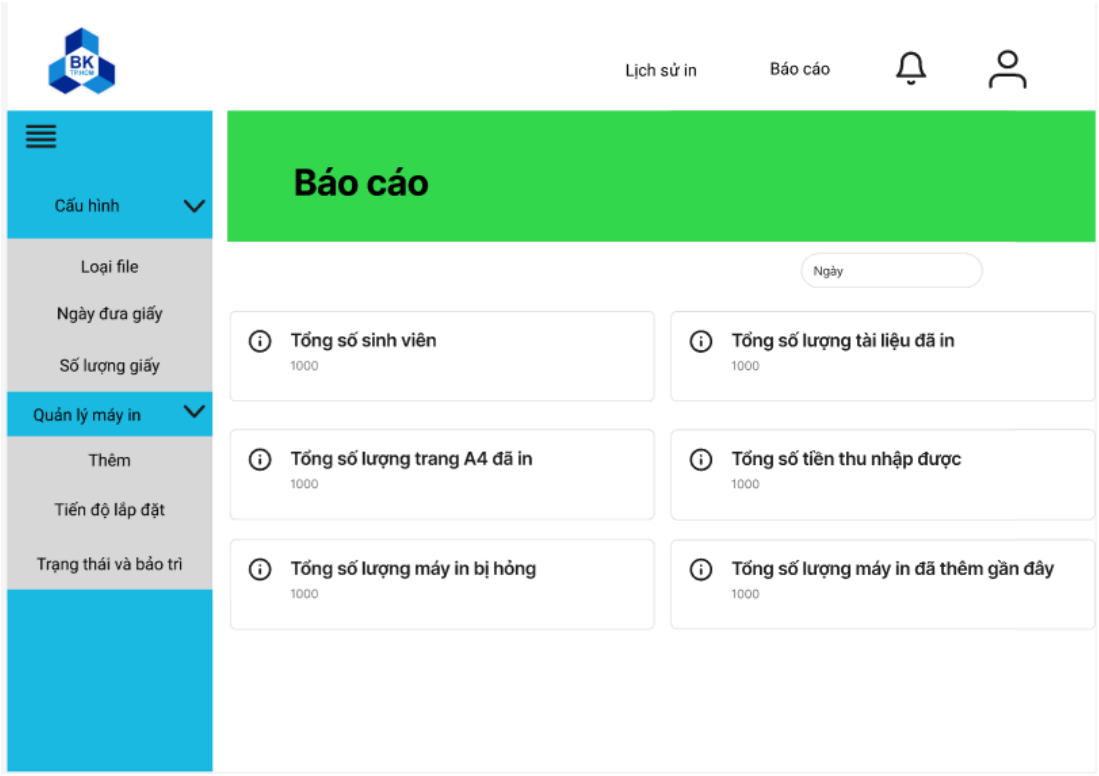


Figure 33: The viewing report option for SPSO

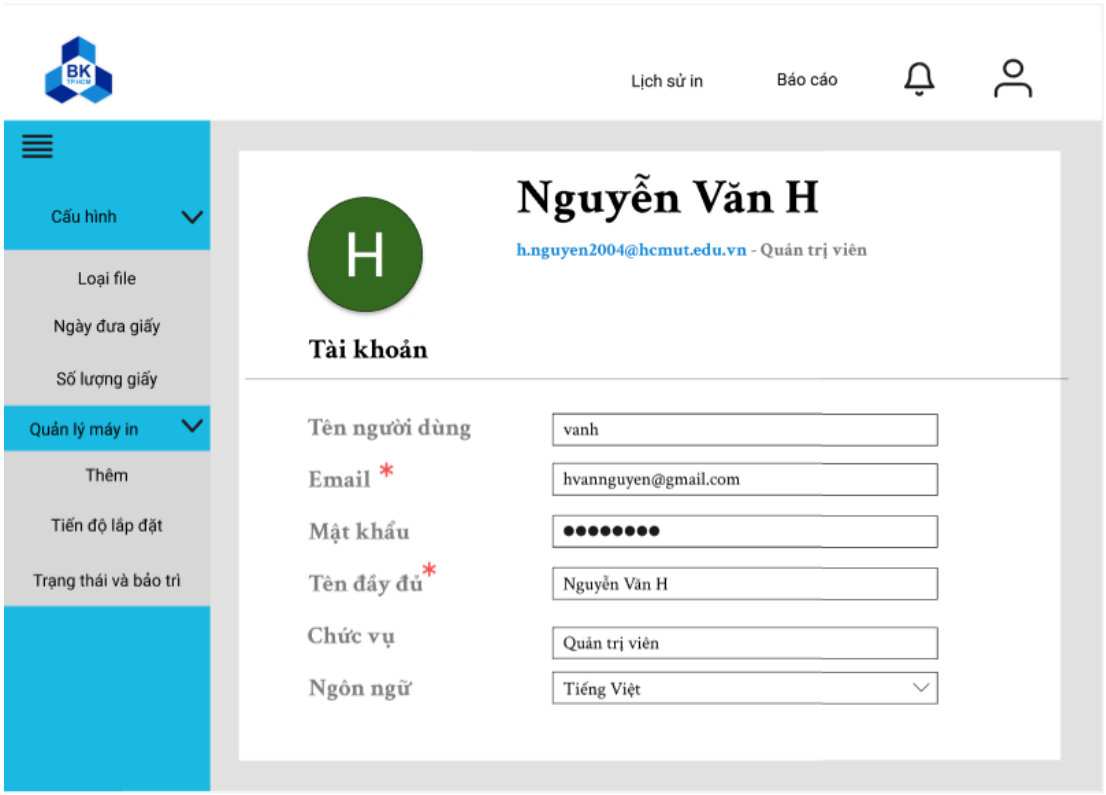


Figure 34: The viewing profile option for SPSO

2. Table description

	Components	Actions	Description
1	Admin icon button	Click	When SPSO clicks the button, the dropdown menu gives SPSO two options: view their profile and logout
2	Bell icon button	Click	The button notifies the SPSO whenever there is a broken printer
3	Printing log link	Click	The web page redirects to the page for viewing printing log
4	Report link	Click	The web page redirects to the page for viewing report page
5	Configuration link	Click	After clicking on the link, SPSO can choose managing items shown on the dropdown menu
6	Managing printer link	Click	After clicking on the link, SPSO can choose managing items shown on the dropdown menu
7	File type link	Click	The web page redirects to the page for managing file type
8	Date giving default papers link	Click	The web page redirects to the page for managing date giving papers
9	Number of default pages link	Click	The web page redirects to the page for managing number of default pages
10	Adding printer link	Click	The web page redirects to the page for adding, viewing and disabling printers
11	Setup progress link	Click	The web page redirects to the page for view setup progresses
12	Status and maintenance link	Click	The web page redirects to the page for managing status of printers
13	Input field in the form	Type or Choose	SPSO can type in the information needed to add or modify.
14	Reset button	Click	SPSO can clear all their value in the input field
15	Submit button	Click	SPSO confirms their information and it to the system

16	Deleting file type button	Click	SPSO can delete the file type by clicking the button
17	Viewing printer's details button	Click	SPSO can view printer's details by clicking the button
18	Disabling printer button	Click	SPOS can disable the printer by clicking the button
19	Search field	Type	SPSO types in their information and the system will sort based on it
20	Number of default pages box	View	SPSO can view the current number of default pages
21	Setup progress table	View	SPSO can view the current progress of printers
22	Status table	View	SPSO can view the status of printers
23	Report container	View	SPSO can view the report
24	Profile container	View	SPSO can view the user's profile in the system

Table 4: Table details application for the manager SPSO

3. More details on the components:

The bell icon button pops up the number of notifications and SPSO can view all of them by clicking on it. Moreover, when the status of some printers goes over 100% or there are requests to the printer and its status still stays at 0%, the system notifies the SPSO via this bell button.

While typing the information in the form, input fields will notify the SPSO when the information is in the wrong format. Moreover, if the SPSO tries to submit while there exists the wrong format of information, the form will also alert the SPSO to correct them.

After redirecting to the page of managing date giving papers, the input field in the form shows the value of the current date. This input field can provide SPSO to either choose the date from the calendar or manually type the date. After submitting, the new value will be updated.

Every time the deleting file type and disabling printer buttons are clicked, they ask the SPSO to confirm the request before actual submission to the system. After that, the system redirects to the current page and new lists of file types and printers are updated.

The number of default pages box displays the current number of pages. After SPSO submits a new value, this box will update the new number of pages.

The status table can also enable the SPSO to disable the printer without redirecting to the managing printer page. When clicking on the button, the SPSO will also be asked to confirm the request before submitting to the system.

4. Task 3: Architectural design (3.1, 3.2)

4.1 System Architecture

4.1.1 Deployment View

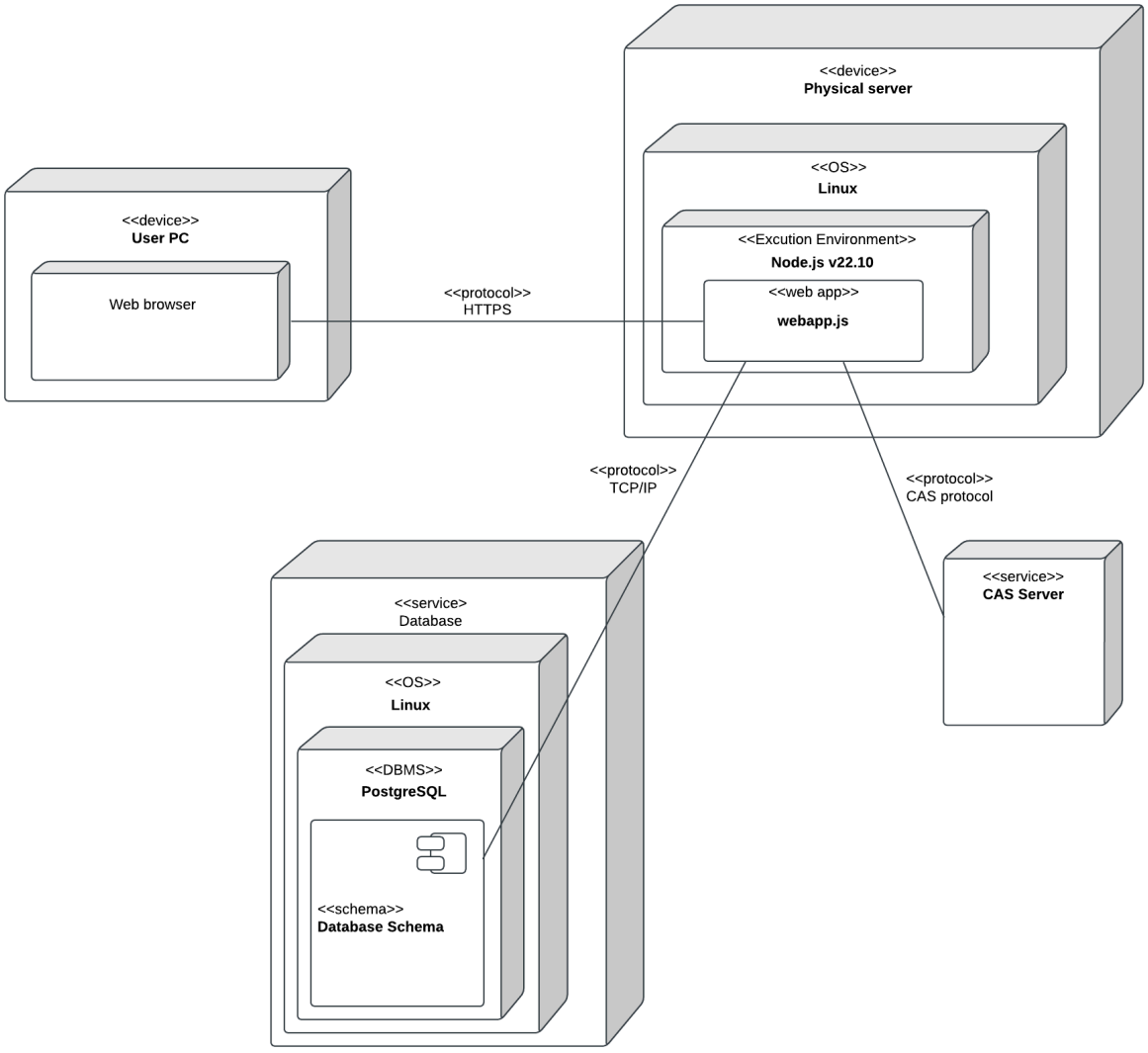


Figure 35: Deployment diagram of system

4.1.2 Overview of Architecture Application

1. Overview

MVC (Model-View-Controller) is a widely used software architecture pattern in web and desktop application development to structure the source code in an organized manner. This pattern divides the application into three main components:

- Model: This component is responsible for data and business logic. It manages data, business rules, and interactions with the database. The Model does not concern itself with how the data is presented or how users interact with it.
- View: This component is the user interface (UI), where users interact with the application. The View receives data from the Model and displays it to the user. It also responds to user actions by sending requests to the Controller.
- Controller: This component acts as a bridge between the Model and the View. The Controller receives user input through the View, processes requests (including interacting with the Model), and updates the View. It defines how the application responds to user events.

Advantage using MVC:

- Clear Separation: MVC separates the system into distinct parts, making it easier to implement and organize the application.
- Multiple Views: It allows data to be displayed in different ways, providing flexibility in how information is presented.
- Independent Changes: Data can be updated without affecting the user interface, allowing for more efficient data management.
- Asynchronous Support: MVC supports asynchronous operations, improving application responsiveness and user experience.

Disadvantages using MVC:

- Complexity for Small Apps: Using MVC in small projects can add unnecessary complexity, making it harder for beginners to understand.
- State Management Issues: Managing the state between the Model, View, and Controller can become difficult as the application grows, leading to potential errors.
- Longer Development Time: Implementing MVC can take more time than simpler frameworks, which may slow down initial development for smaller applications.

2. MVC diagram

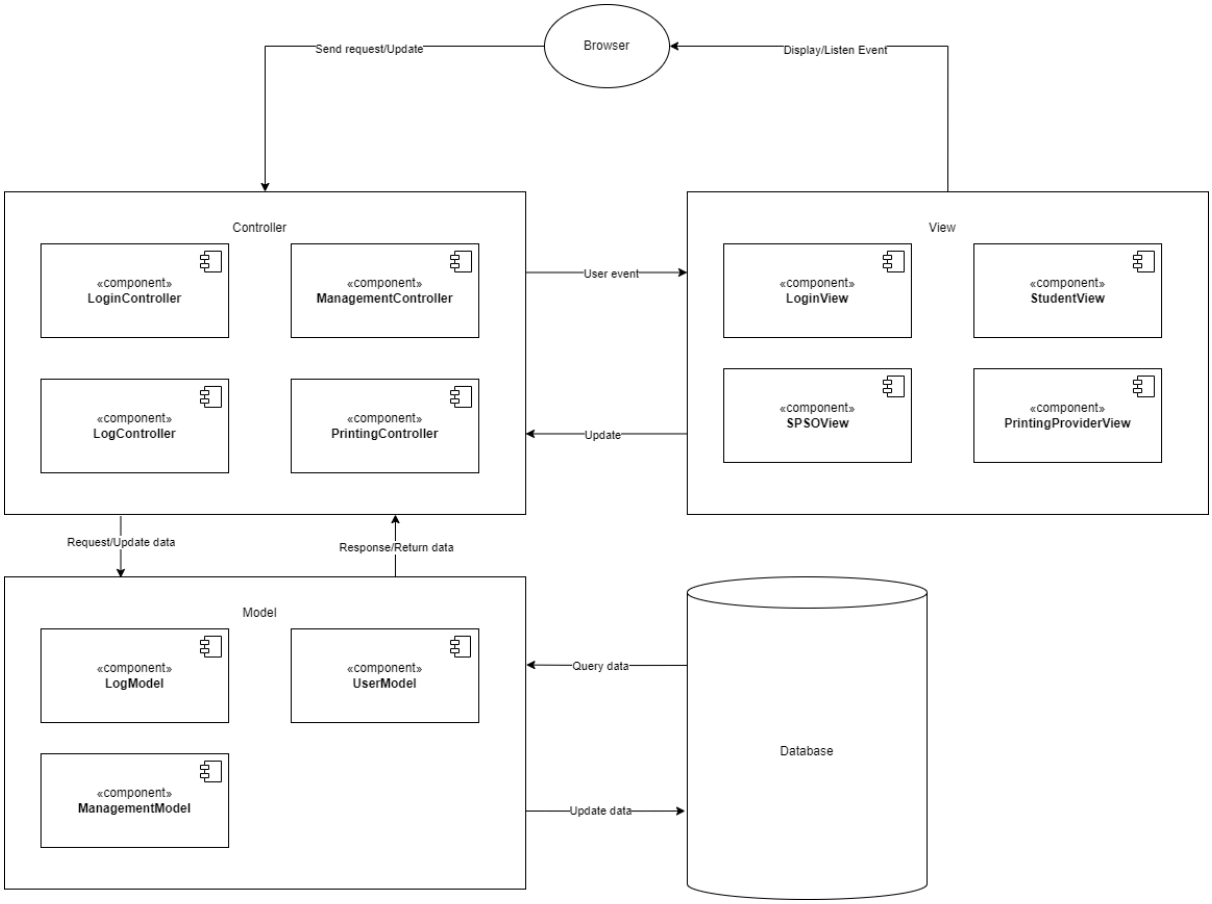


Figure 36: MVC diagram of system

- Controller
  - LoginController: Manages user authentication and login requests.
  - ManagementController: Manages system settings, printer management, page purchases, etc.
  - LogController: Handles logs and tracks user/system activities.
  - PrintingController: Controls operations related to printing requests.
- View
  - LoginView: Displays the login interface and listens for login-related actions.
  - StudentView: Provides the interface specifically for student interactions.
  - SPSOView: Provides the interface specifically for SPSO interactions.
  - PrintingProviderView: Provides the interface specifically for Printer Provider interactions.
- Model
  - LogModel: Manages logging data storage and interfaces with the database.
  - UserModel: Manages user data and interfaces for CRUD operations related to user information.
  - ManagementModel: Manages data storage for system/user management tasks, integrating with the Management and Printing Controllers for CRUD and updates.

4.1.3 Description for Architecture Decision

1. Presentation Strategy:

The presentation layer of HCMUT_SSPS will use a web-based and mobile-friendly interface to provide accessibility and ease of use for students, SPSO officers, and printer providers. The user interface will be developed using HTML, CSS, and JavaScript, and will be accessible through any standard web browser.

Key Reasons for this Strategy:

- User Accessibility: Students, SPSO officers, and printer providers can access the system from any device with a web browser.
- Consistency: A single, responsive web interface ensures consistent user experience across devices.
- Scalability: Web-based interfaces are easier to update and scale as the system grows or new features are added.

2. Data Storage Approach:

The HCMUT_SSPS system will use a relational database model with PostgreSQL as the database management system (DBMS).

Reasons for Choosing PostgreSQL:

- Reliability and Stability: PostgreSQL is highly reliable, suitable for mission-critical applications.
- ACID Compliance: Ensures data integrity with reliable transaction support.
- Support for Complex Data Types: Handles JSON, XML, and unstructured data types.
- Scalability and High Performance: Supports replication and partitioning, with strong performance optimization options.
- Extensibility: Allows custom functions, data types, and support for multiple programming languages.

Database Structure:

- User Database: Stores information about users, including students and SPSO officers.
- Printer Database: Contains details about each printer, such as location and status.
- BKPay Database: Manages transactions related to the purchase of printing pages by students.
- Requirement Database: Maintains information on system requirements and settings.
- File Database: Stores document information and printing logs.

3. API Management:

To support system functionality, HCMUT_SSPS uses two types of APIs: internal and external.

- Internal API:
    - Printer API: Developed internally, this API manages document printing requests by handling printer-specific operations. This API ensures smooth interaction between the system and the printers on campus, allowing for document processing, printing, and status monitoring.
- External APIs:

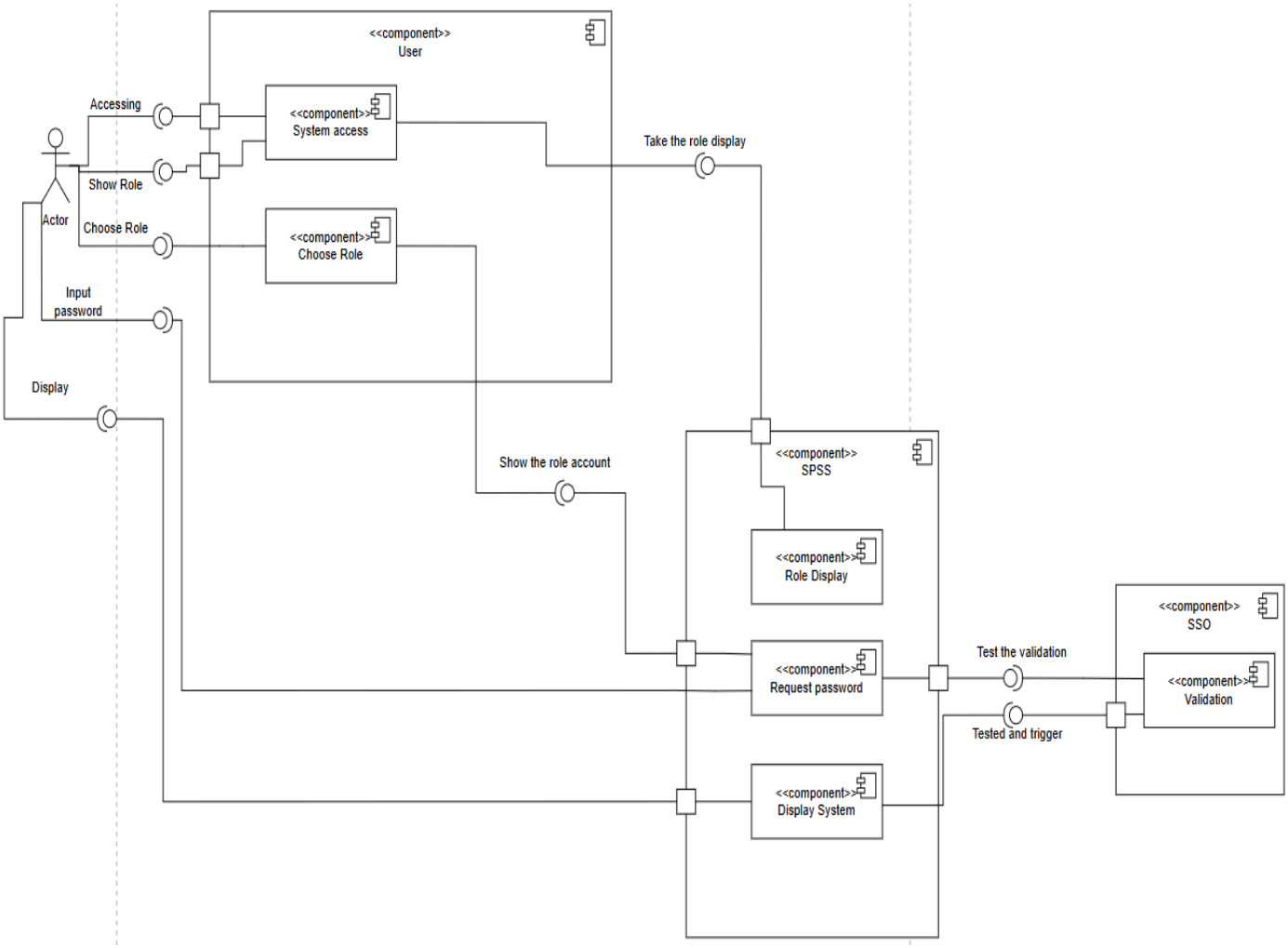
- Apero CAS Authentication API: Used for authenticating users, including students and SPSO officers, by integrating with the university's Central Authentication Service (CAS) system.
- BKPay Payment API: Supports the "Buy Printing Pages" feature, allowing students to purchase additional pages using the university's BKPay payment platform.

API Strategy:

- Internal APIs allow for better control and customization of printer operations specific to HCMUT's requirements.
- External APIs ensure integration with university-wide services, enhancing user experience and enabling secure authentication and payment processes.

4.2 Component diagrams

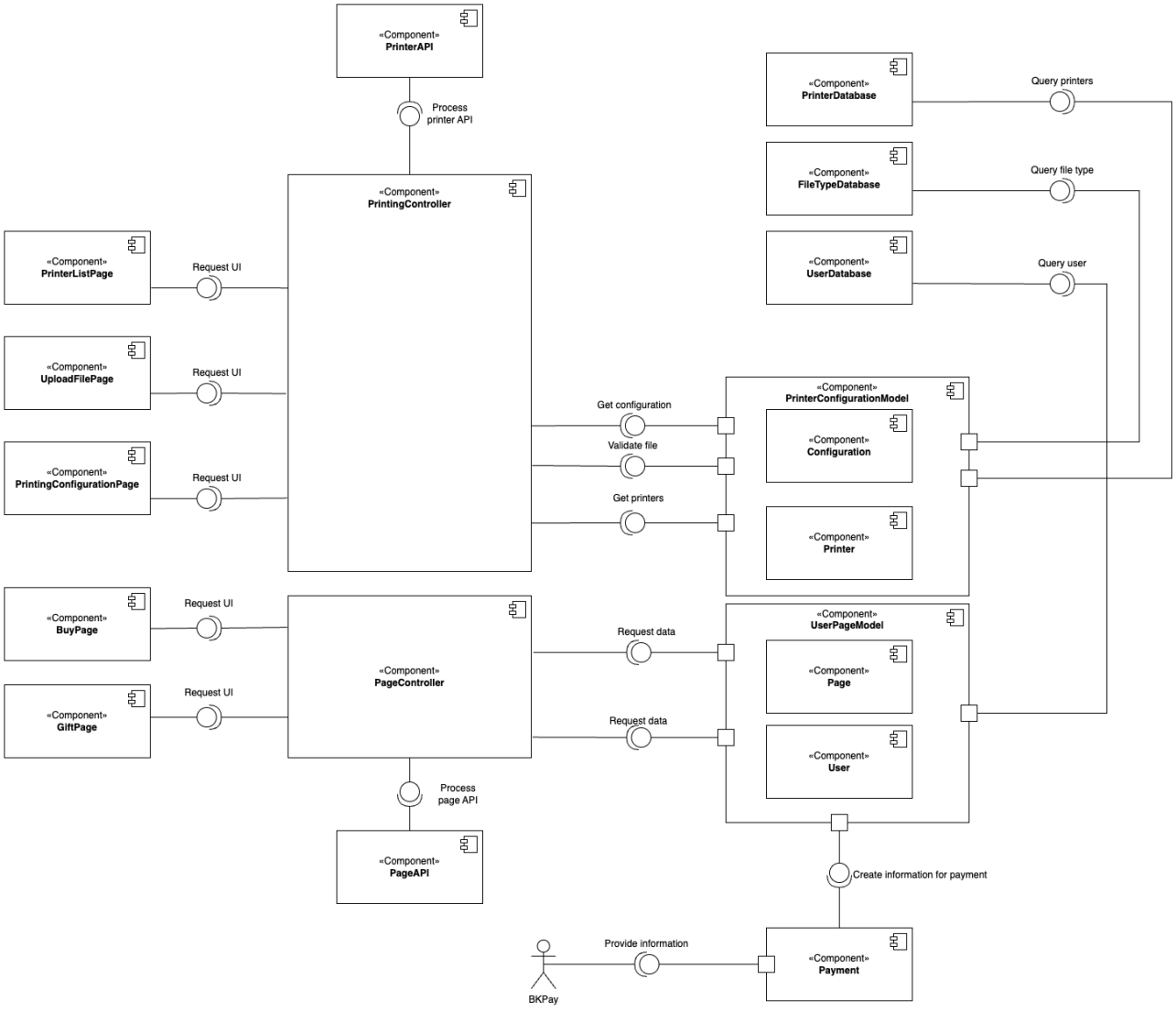
4.2.1 Authentication



The component diagram shows every component that is relating to the Authentication activity. Showing how an actor (user) gains access to the system through role selection, password input, and validation. Here is more detailed information of the component diagram.

1. **Access and Choose role (The user component):** First when the user uses this software, they start by accessing the system and are prompted to choose a role. The actor selects the desired role through the "Choose Role" component, which leads to a display of the role-specific interface.
2. **Role display, asking for the password and Display the system (The SPSS component):** After choosing the correct role of the user. The actor is then required to input a password to continue. This password request is managed by the "Request Password" component, ensuring that the user is authenticated before proceeding. Then after the component validation approved the password, which also means that the authentication is successful. The system will be displayed for the actor.
3. **The validation component (The SSO component):** This component just simply takes the password and username to check if they are authenticated or not. The diagram ends with the "Display System" component, which confirms successful access by displaying the system interface to the user based on their selected role.

4.2.2 Print a document



This component diagram represents the architecture of a print document management system, showing the interactions between various components and databases required for processing print requests and managing user information.

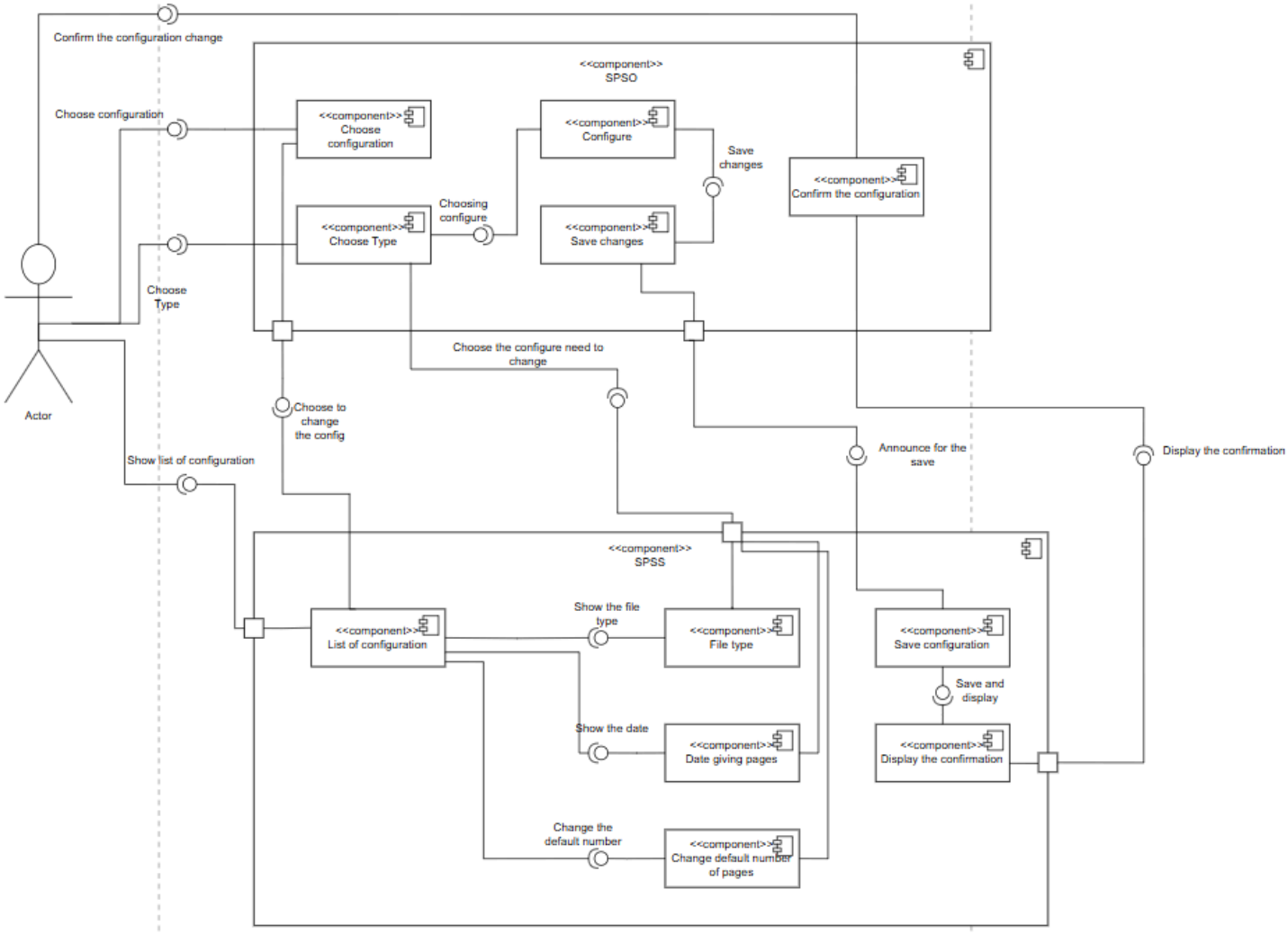
The primary component, PrintingController, processes the API calls by requesting several UI components, such as PrinterListPage, UploadFilePage, PrintingConfigurationPage. The other controller, PageController, processes the API calls and requests BuyPage, and GiftPage, to handle different user actions. These pages initiate requests to the controller, which then manages the flow of data and operations within the system.

The PrinterConfigurationModel and UserPageModel components are responsible for fetching configurations and user data, respectively. PrinterConfigurationModel includes Configuration and Printer subcomponents, which help retrieve printer settings and available printers. Similarly,

UserPageModel contains Page and User subcomponents to access page details and user-specific information.

Databases such as PrinterDatabase, FileTypeDatabase, and UserDatabase support data queries for printers, file types, and user information. The Payment component works with an external payment actor, BKPay, to facilitate payment processing. This diagram effectively illustrates the overall data flow and component interactions in a structured manner, highlighting the core dependencies for print document handling.

4.2.3 Configuration

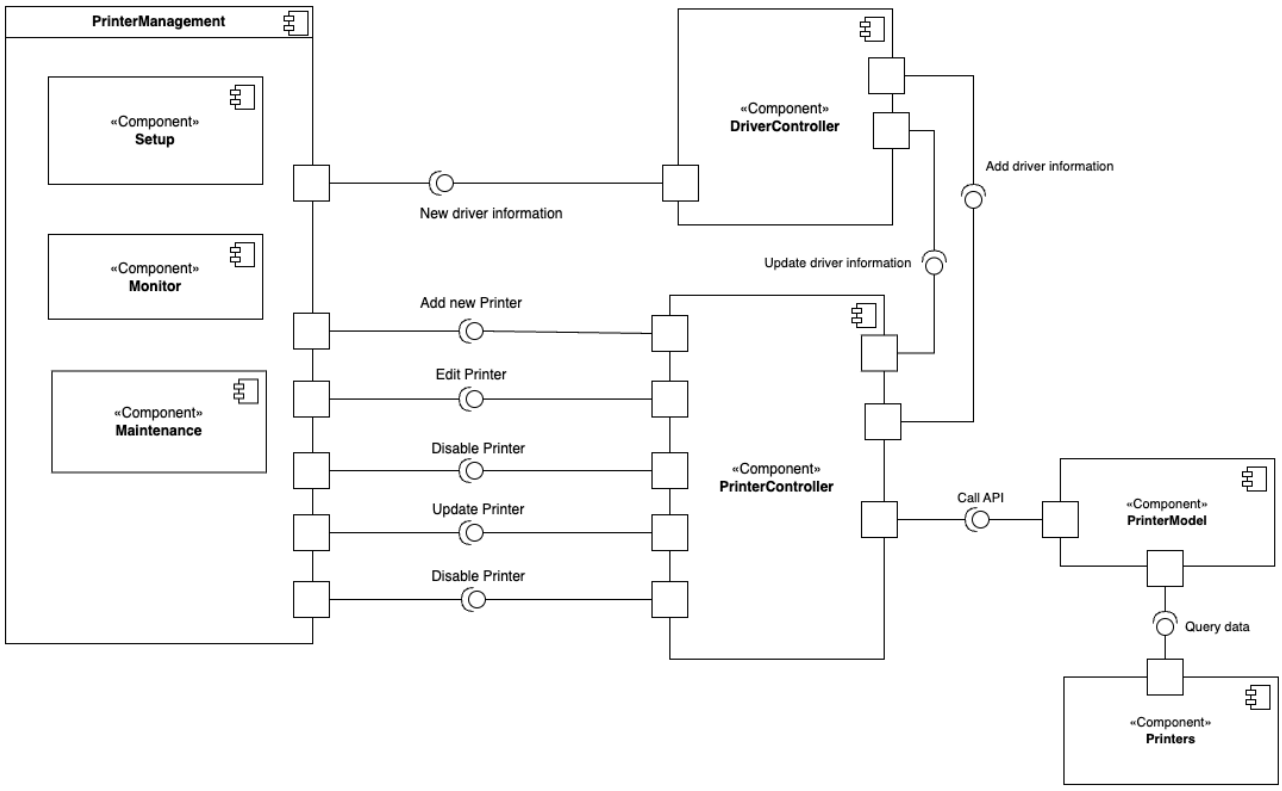


The component diagram shows every component that is relating to the Configuration activity. Showing how an actor (user) changes some configuration and saves it. Here is more detailed information of the component diagram.

1. **The SPSO component:** The actor is choosing the configuration needed changing in their interface. And then confirm all the configuration changes they have made. All the choosing and the confirms must be saved at another component.

2. **The SPSS component:** This component is the group showing the configuration or like the store saving the changes configuration.

4.2.4 Printer Management



The component diagram above shows every component that is related to the printer management. This diagram illustrates how SPSO can manage the printers in the system. Details of the diagram are shown below:

1. **Setup Component:** SPSO fills in the information of the driver and then submits it to the component that is responsible for processing.
2. **Monitor Component**: SPSO can choose to add, edit or disable the printer.
3. **Maintenance Component**: SPSO can modify the state (on/off) of printers without viewing the Monitor Component.
4. **DriverController Component**: Information received from the Setup Component is decided to validate before adding or updating the driver's information.
5. **PrinterController Component**: Information received from the Component interacting with printers is organized to go to the addition, update or disabling.
6. **PrinterModel Component**: The Controller Component can call the API from this Component without actual interaction with the database.
7. **Printers Component**: This Component does raw queries to the database and returns the result corresponding to the request.