Ho Chi Minh City University of Technology

Faculty of Computer Science and Engineering

Software Engineering (CO3001)

Student Smart Printing Service

Report 4 - Task 3

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Completion date: 10th November, 2023

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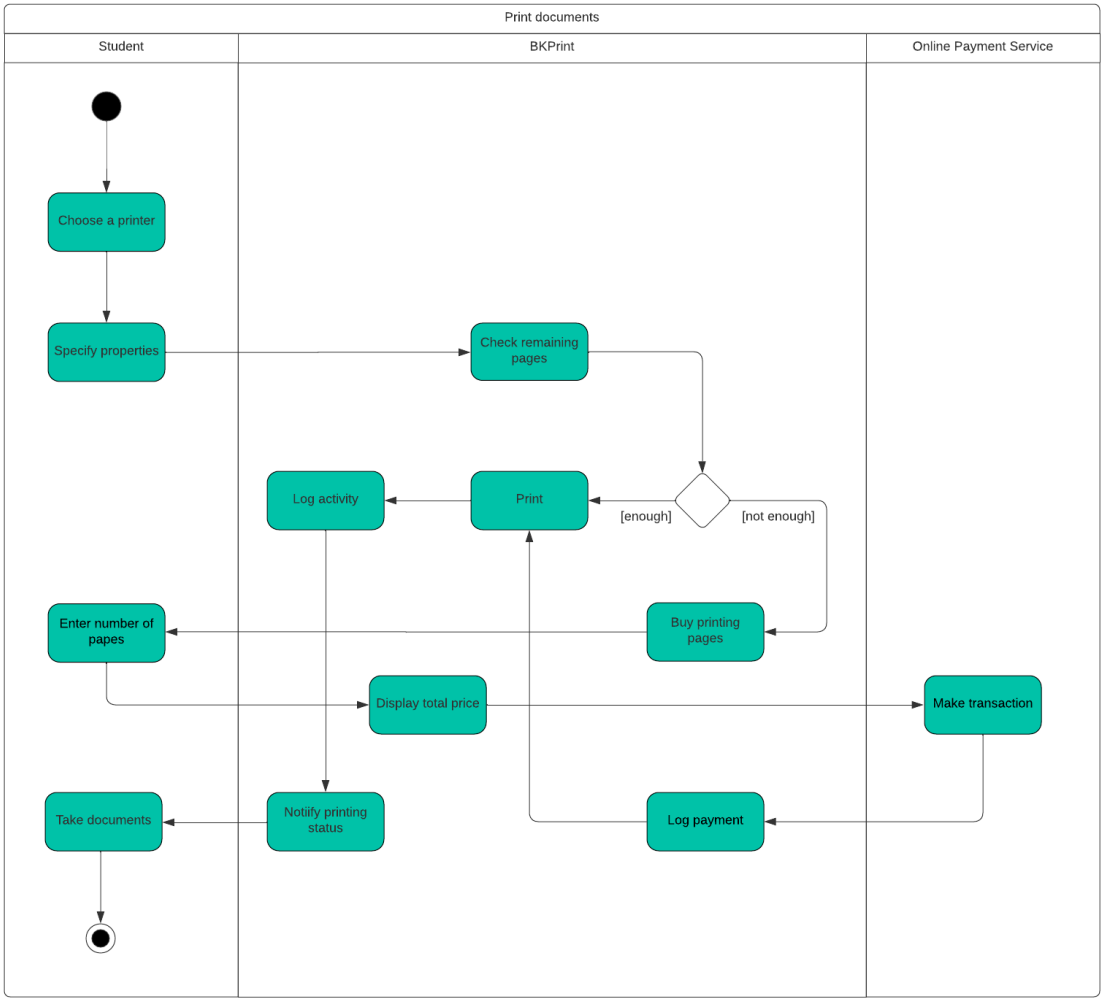
1 Introduction

This Modeling Document is a crucial component in designing and comprehending the BKPrint system. It consists of various visual representations, including Activity Diagrams, Sequence Diagrams, a Class Diagram, and the developed MVP 1 User Interface. These elements provide a comprehensive view of system-stakeholder interactions, chronological flow, structural design, and a tangible representation of the central dashboard for the chosen modules.

2 Activity Diagram

2.1 "Print Document" module



Hình 1: The *Print Document* Activity Diagram

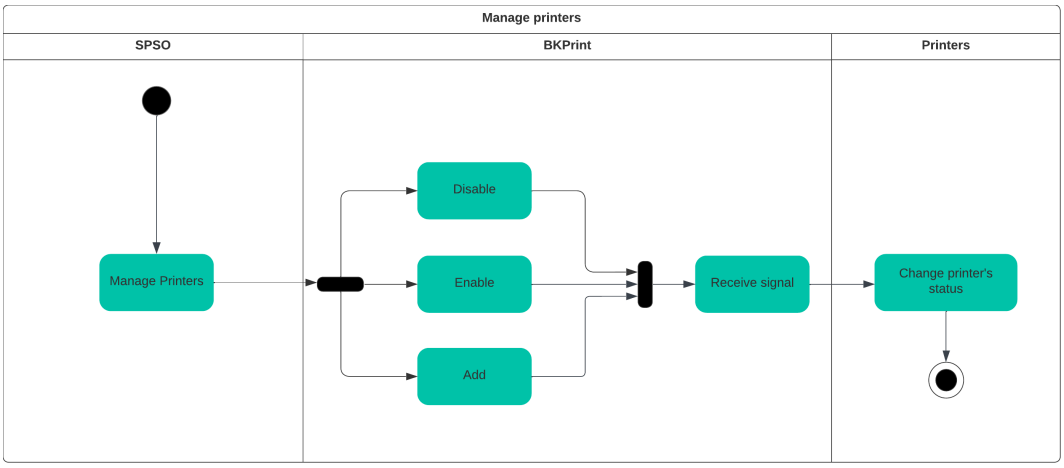
The diagram illustrates the document printing process for students using BKPrint, an online printing service, involving three key swimlanes: **Student, BKPrint,** and **Online**

Payment Service. **Students** begin by selecting a printer from various building locations and specifying their printing preferences, such as paper size, the number of copies, and single-sided or double-sided printing. If the student's page balance is sufficient, **BKPrint** proceeds with the document printing. In cases of insufficient pages, **BKPrint** prompts the student to purchase the necessary pages, with the student entering the page count. **BKPrint** calculates and displays the total price that student need to pay, then sends a request to the **Online Payment Service** to make transaction. Upon a successful transaction, payment details are logged, and the document is printed according to the student's specifications. This streamlined process ensures efficient and convenient printing for students, optimizing resource management and payment handling.
From the **Print** step in the diagram, there are two consecutive directions:

1. Activity is logged: **BKPrint** logs the printing activity so that the student can track their printing usage.

2. Printing status is notified: **BKPrint** notifies the student about the printing status, such as when the document is printing, finished printing, or cancelled.

2.2 "Manage Printer" module

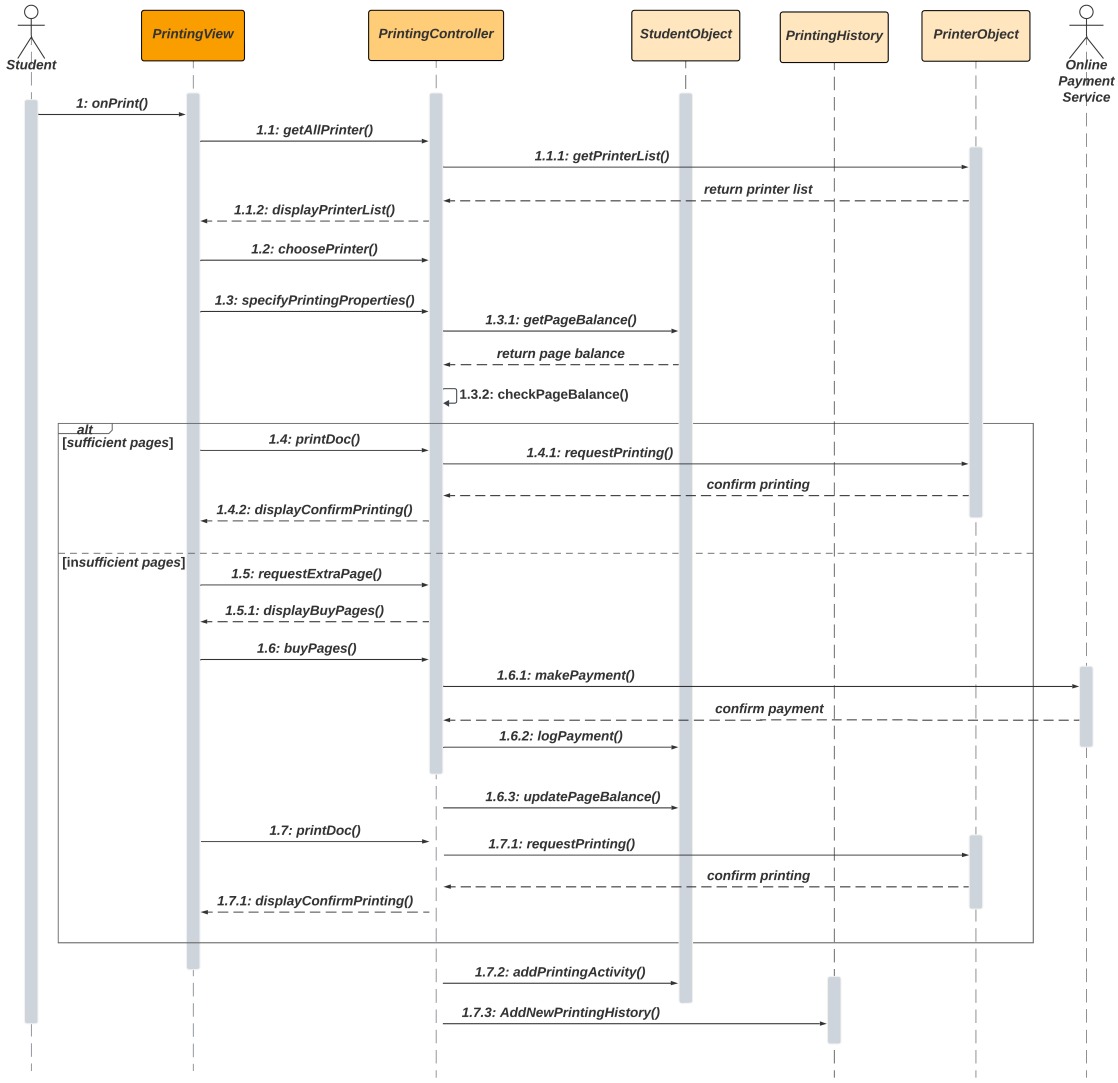


Hình 2: The *Manage Printer* Activity Diagram

In the system represented by the diagram, three key swimlanes play distinct roles in the management of printers: **SPSO** (System Print Service Operator), **BKPrint** (Printer Control Interface), and **Printers**. **SPSO** serves as the primary decision-maker, responsible for initiating printer management tasks. These tasks include three essential options: Disable, Enable, and Add. When **SPSO** decides to take action, it sends signals to **BKPrint**, which acts as an intermediary between the operator and the fleet of printers. These instructions pertain to changing the status of printers, such as disabling one to halt printing activities, enabling another for use, or adding a new printer to the system.

3 Sequence Diagram

3.1 "Printing Document" module



Hình 3: The *Printing Document* Sequence Diagram

The depicted sequence diagram involves two primary actors: **Student, Online Payment Service** , along with five key objects: **PrintingView, PrintingController, StudentObject, PrintingHistory** and **PrinterObject**. When the **Student** initiates the onPrint() action, the **PrintingView** triggers the **getPrinterList()** method to retrieve and exhibit the available printers. Subsequently, the **PrintingView** engages **choosePrinter()** to suggest students to select their preferred printer and then calls **specifyPrintingProperties()** to elicit user input on printing properties such as paper size and number of copies.

The **PrintingController** assumes a vital role in the **printDoc()** method, commencing with a call to **getPageBalance()** from **StudentObject**. Following the retrieval of page

balance information, the **PrintingController** proceeds to **checkPageBalance()**. This critical method then leads to one of two possible scenarios:

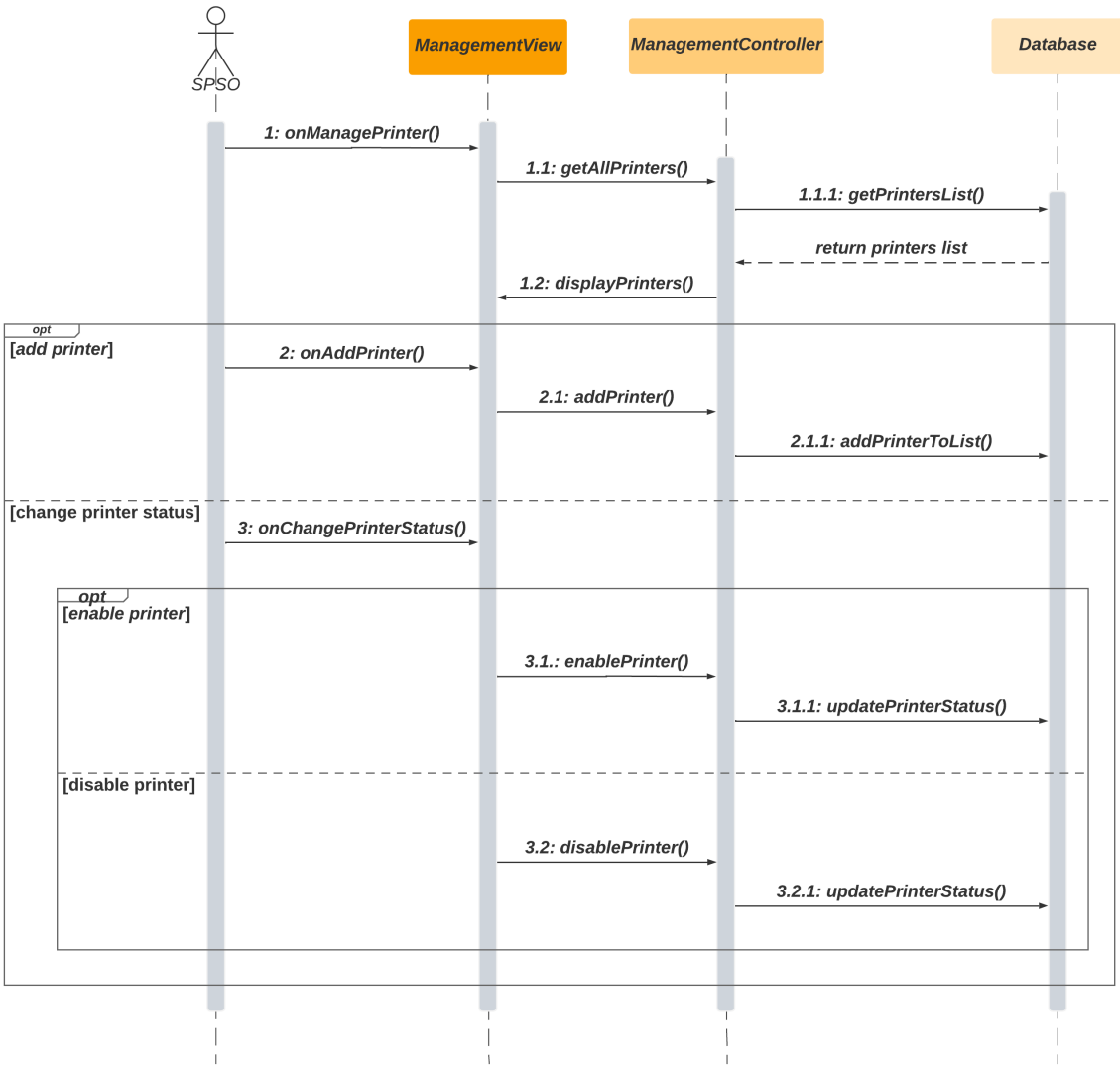
1. If the available page count is sufficient, the **PrintingController** invokes **requestPrinting()** on **PrinterObject** to ensure confirmation of the printing activity. Subsequently, **displayConfirmPrinting()** is triggered by the **PrintingController** before concluding the process.

2. In cases where the page count is insufficient, **displayBuyPages()** is triggered by **PrintingView**, prompting the student to purchase more pages. This involves a call to **buyPages()** from **PrintingView** to the **PrintingController**, triggering a series of synchronized methods.

    - The **PrintingController** initiates **makePayments()** to the Online Payment Service, receiving a confirmation message to validate the transaction.
    - Following payment confirmation, **logPayment()** is called by the **PrintingController** on **StudentObject** to record the transaction in the database.
    - With the successful storage of the transaction, **updatePageBalance()** is invoked by the **PrintingController** on **StudentObject** to reflect the new page balance.
    - After purchasing additional pages and updating the database, **PrintingView** reinvokes **printDoc()** to **requestPrinting()** on **PrinterObject**. It is noteworthy that the subsequent flow mirrors that of the scenario with sufficient pages.

Finally, The **printDoc()** method concludes as the **PrintingController** calls **addPrintingActivity()** on **StudentObject** and **addNewPrintingHistory()** on **PrintingHistory** to store the printing activity details.

3.2 "Manage Printer" module



Hình 4: The *Manage Printer* Sequence Diagram

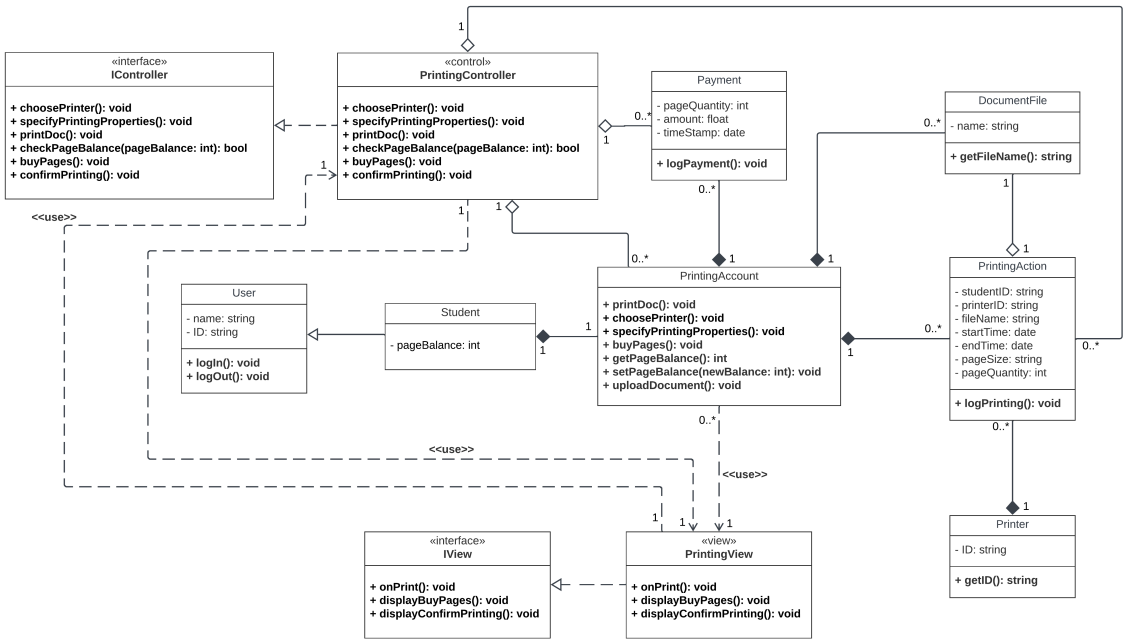
The above sequence diagram contains **SPSO** as the only actor and 3 objects: **ManagementView, ManagementController, Database**. When **SPSO** calls the **onManagePrinter()**, object **ManagementView** calls the **getAllPrinter()**, object **ManagementController** calls the **getPrintersList()** and request the database return all the printer's information. After that, **ManagementController** returns printer's information to the **ManagementView** through the method **displayPrinters()**.
Beside checking list of printers, the **Manage Printer** module also contains 2 more optional method.

1. When **SPSO** calls **onAddPrinter()**, **ManagementView** calls the **addPrinter()** to the **ManagementController**, and the **ManagementController** calls the **addPrinterToList()** to the database and the database will create and add a new printer item into the list.

2. When **SPSO** calls **onChangePrinterStatus()** to the **ManagementView**. The **ManagementView** can optional call **DisablePrinter()** or **EnablePrinter()** to the **ManagementController** to enable or disable a specific printer. In order to perform the method **EnablePrinter()** or **DisablePrinter()**, the **ManagementController** calls the **updatePrinterStatus()** to the database and the database will update the status of the chosen printer.

4 Class Diagram

4.1 "Printing Document" module



Hình 5: The *Print Document* Class Diagram

The above class diagram shows components in the system based on Model-View-Controller (MVC) pattern when a student prints document. The module includes classes **IController** and **IView** as interfaces; class **PrintingController** as controller and class **PrintingView** as view; classes **User**, **Student**, **PrintingAccount**, **Payment**, **DocumentFile**, **PrintingAction**, **Printer** as data model.

The relationships and multiplicity are also contained in the class diagram:

1. Inheritance relationship:

    - The class **Student** is a sub-class of the class **User**. **Student** inherits all attributes and methods from **User** while having its own attribute, which is **pageBalance**.

2. Realization relationship:

    - The class **PrintingController** provides concrete implementation for the methods defined in the class **IController**.
    - The class **PrintingView** provides concrete implementation for the methods defined in the class **IView**.

3. Aggregation relationship:

    - The class **PrintingController** has aggregation relationship with the class **PrintingAction**, which means **PrintingController** has many **PrintingAction** to control, and when **PrintingController** is destroyed, **PrintingAction** still exists. A **PrintingController** can have zero or more **PrintingAction**, while a **PrintingAction** can belong to 1 and only 1 **PrintingController**.
    - The class **PrintingController** has aggregation relationship with the class **Payment**, which means **PrintingController** has many **Payment** to control, and when **PrintingController** is destroyed, **Payment** still exists. A **PrintingController** can have zero or more **Payment**, while a **Payment** can belong to 1 and only 1 **PrintingController**.
    - The class **PrintingAccount** has aggregation relationship with the class **PrintingController**, which means **PrintingController** has many **PrintingAccount** to control, and when **PrintingController** is destroyed, **PrintingAccount** still exists. A **PrintingController** can have zero or more **PrintingAccount**, while a **PrintingAccount** can belong to 1 and only 1 **PrintingController**.
    - The class **DocumentFile** has aggregation relationship with the class **PrintingAction**, which means **PrintingAction** has **DocumentFile** and when **PrintingAction** is destroyed, **DocumentFile** still exists. A **PrintingAction** can have 1 and only 1 **DocumentFile**, and a **DocumentFile** can belong to 1 and only 1 **PrintingAction**

4. Composition relationship:

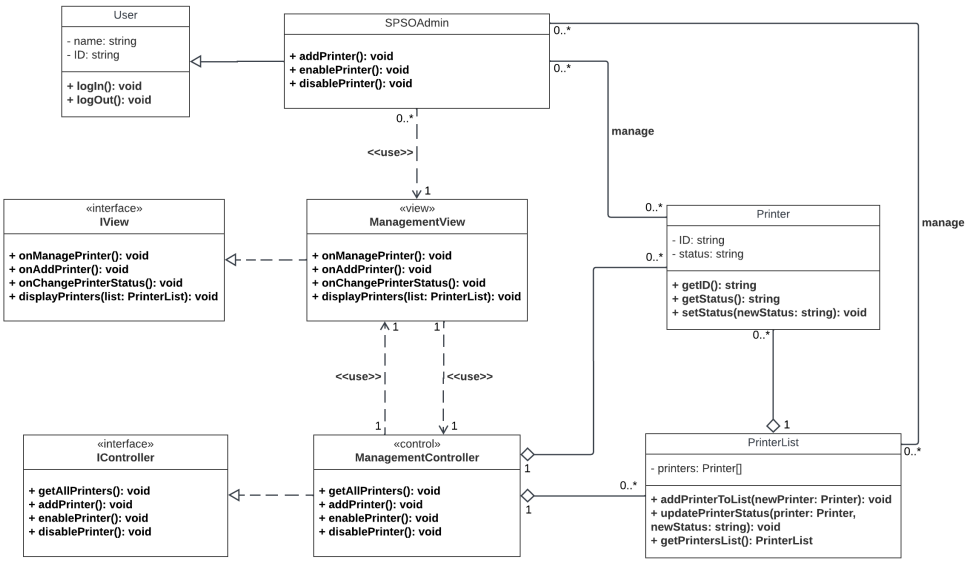
    - The class **PrintingAccount** has composition relationship with the class **Student**, which means **Student** has only one **PrintingAccount**, but when **Student** is destroyed, **PrintingAccount** is also destroyed. A **Student** can only one **PrintingAccount**, but a **PrintingAccount** can belong to 1 and only 1 **Student**.
    - The class **PrintingAccount** has composition relationship with the class **DocumentFile**, which means **PrintingAccount** has many **DocumentFile**, but when **PrintingAccount** is destroyed, **DocumentFile** is also destroyed. A **PrintingAccount** can have zero or more **DocumentFile**, but a **DocumentFile** can belong to 1 and only 1 **PrintingAccount**.

- The class **PrintingAccount** has composition relationship with the class **PrintingAction**, which means **PrintingAccount** has many **PrintingAction**, but when **PrintingAccount** is destroyed, **PrintingAction** is also destroyed. A **PrintingAccount** can have zero or more **PrintingAction**, but a **PrintingAction** can belong to 1 and only 1 **Student**.
- The class **PrintingAccount** has composition relationship with the class **Payment**, which means **PrintingAccount** has many **Payment**, but when **PrintingAccount** is destroyed, **Payment** is also destroyed. A **PrintingAccount** can have zero or more **Payment**, but a **Payment** can belong to 1 and only 1 **PrintingAccount**.
- The class **Printer** has composition relationship with the class **PrintingAction**, which means **Printer** has many **PrintingAction**, but when **Printer** is destroyed, **PrintingAction** is also destroyed. A **Printer** can have zero or more **PrintingAction**, but a **PrintingAction** can belong to 1 and only 1 **Printer**.

5. Dependency relationship:

- The class **PrintingView** has dependency relationship with the class **PrintingController**, which means **PrintingView** uses methods in **PrintingController**. A **PrintingView** uses methods in 1 **PrintingController**, and a **PrintingController** is used by 1 **PrintingView**.
- The class **PrintingController** has dependency relationship with the class **PrintingView**, which means **PrintingController** uses methods in **PrintingView**. A **PrintingController** uses methods in 1 **PrintingView**, and a **PrintingView** is used by 1 **PrintingController**.
- The class **PrintingAccount** has dependency relationship with the class **PrintingView**, which means **PrintingAccount** uses methods in **PrintingView**. A **PrintingAccount** uses methods in 1 **PrintingView**, and a **PrintingView** is used by zero or more **PrintingAccount**.

4.2 "Manage Printer" module



Hình 6: The *Manage Printer* Class Diagram

The above class diagram illustrates components in the system and theirs relationships in Model-View-Controller (MVC) pattern where a user, specific SPSO admin manage the printers. The **User, SPSOAdmin, PrinterList** and **Printer** class are model. The view module includes **ManagementView** class and **IView** is its interface. The controller module is the **ManagementController** class, using to control the whole system. Its interface called **IController**.

In addition, the relationships depicted can be clearly seen in the provided class diagram:

1. Inheritance relationship:
    - The class **SPSOAdmin** inherits from the class User. This relationship signifies that a SPSOAdmin is a specialized type of User, inheriting all the attributes such as name and ID and methods of the User class including login() and logOut().
2. Realization relationship:
    - The class **ManagementView** implements the interface **IView**, indicating that **ManagementView** provides concrete implementations for all the methods defined in the **IView** interface.
    - With the implementation of the **IController** interface, the **ManagementController** class provides specific realizations for all the methods defined within the interface.
3. Aggregation relationship:

- The class **PrinterList** has an aggregation relationship with the class **Printer**. The **PrinterList** class manages a collection of Printer objects, enabling operations related to organizing and manipulating multiple instances of the Printer class. The multiplicity between the **PrinterList** class and the Printer class is one-to-many, meaning that a single **PrinterList** instance can manage multiple instances of the **Printer** class.
- The class **ManagementController** has an aggregation relationship wit with the **PrinterList** class, signifying that the **ManagementController** class manages instances of the **PrinterList** class. the multiplicity is one-to-many, indicating that a single **ManagementController** instance manages many **PrinterList** instances.
- **ManagementController** class has an aggregation relationship with the class Printer, so it can perform various functions related to managing and coordinating the behaviour of the Printer instances within the system. The multiplicity between them is one-to-many, suggesting that a single **ManagementController** instance can control multiple Printer instances within the system.

4. Dependency relationship:

   - The **SPSOAdmin** class has a dependency relationship with the **ManagementView** class. **SPSOAdmin** class *use* the **ManagementView** class. The multiplicity between the **SPSOAdmin** class and the **ManagementView** class is denoted as many to 1, each instance of **SPSOAdmin** is associated with exactly one instance of **ManagementView**, and each instance of **ManagementView** is associated with zero or more instance of **SPSOAdmin**.
   - The **ManagementView** class depends on the functionalities provided by the **ManagementController** class to handle and manage various control operations within the system's view. The **ManagementView** class *use* the **ManagementController** class. The multiplicity between the **ManagementView** class and the **ManagementController** class is denoted as 1 to 1, indicating a one-to-one relationship, where each instance of the view relies on exactly one instance of the controller to handle its functionalities and control operations within the system's view.
   - The **ManagementController** class depends on the functionalities provided by the **ManagementView** class to interact with and manage the view components and related operations within the system. The **ManagementController** class *use* the **ManagementView** class. The multiplicity is typically denoted as 1 to 1, implying a one-to-one relationship.

5. Association relationship:

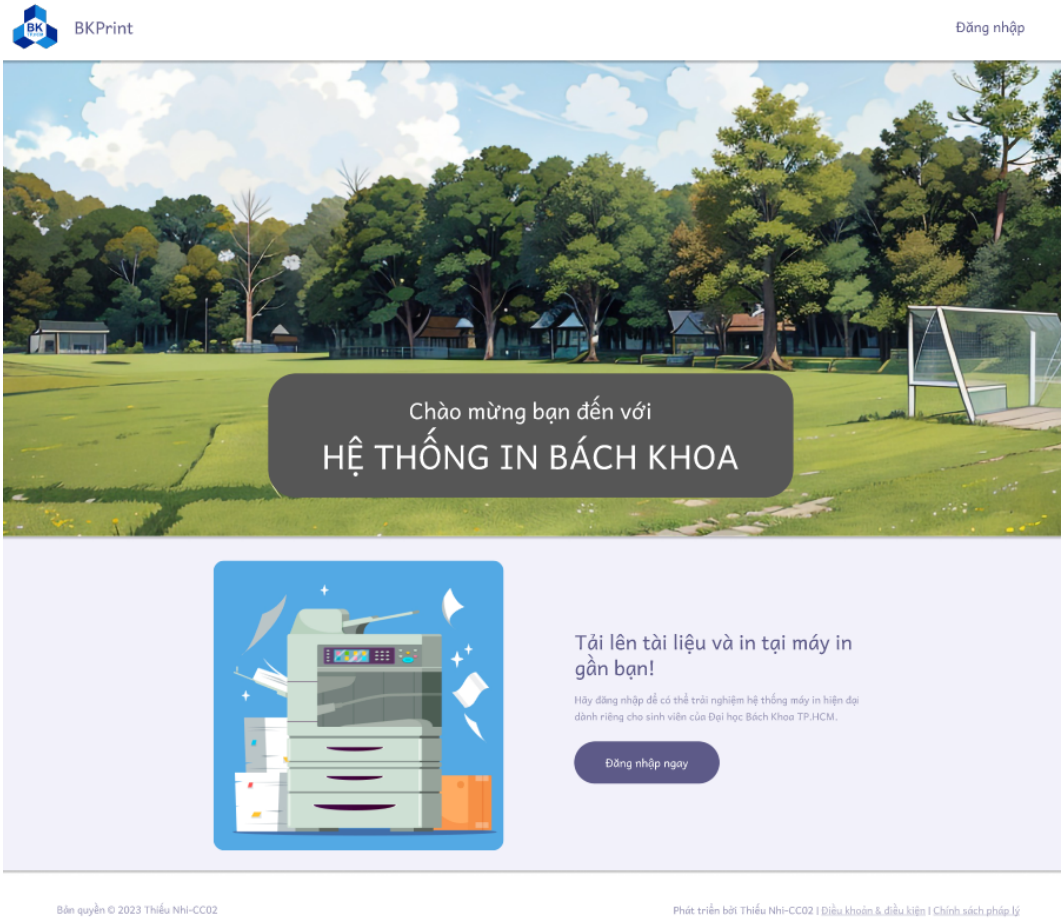
   - The association relationship between the **SPSOAdmin** class and **PrinterList** class allows the **SPSOAdmin** to manage and control the status of a list of

printers, as well as add new printers to the existing list and update their statuses (enable or disable) as required. The multiplicity between them is many-to-many, allowing multiple instances of the **PrinterList** class to be managed by a single instance of the **SPSOAdmin** class and conversely.

- The **SPSOAdmin** class is also associated with the Printer class, enabling the **SPSOAdmin** to manage and perform various operations related to the individual printers such as enable, disable, or add new printers to the system as needed as well as access printer-specific functionalities such as printer ID and status. This is a many-to-many relationship, indicating that multiple instances of the **SPSOAdmin** class can be associated with multiple instances of the **Printer** class and ver vice.

5 User Interface

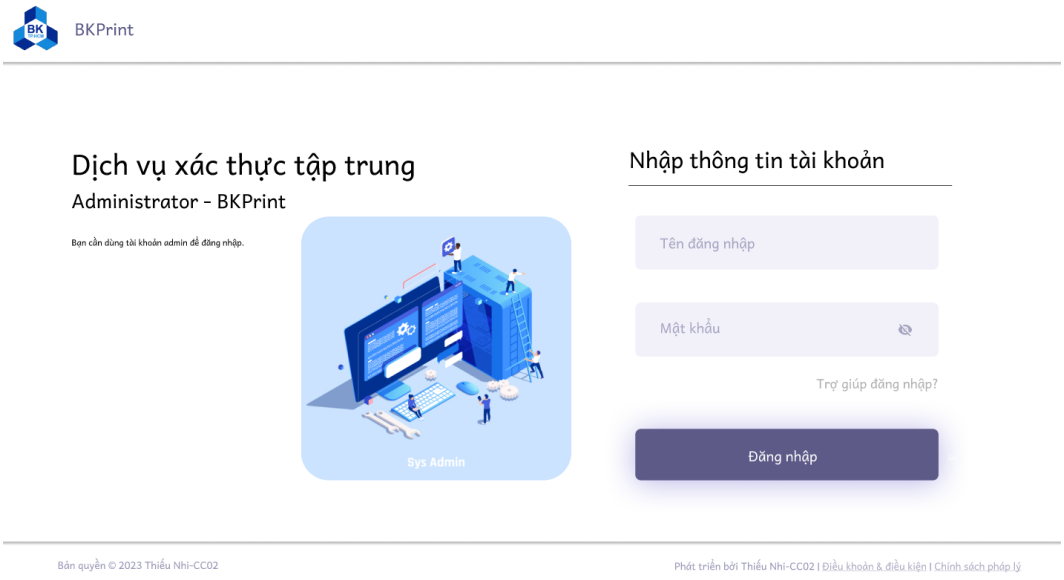
Based on the above diagrams, the UI interface was designed to visualize the app. This section generally explains the UI design. For further experiment, please check the link which reference to the Figma design.
Overall, the design contains 24 frames which show the interface of the BKPrint app.



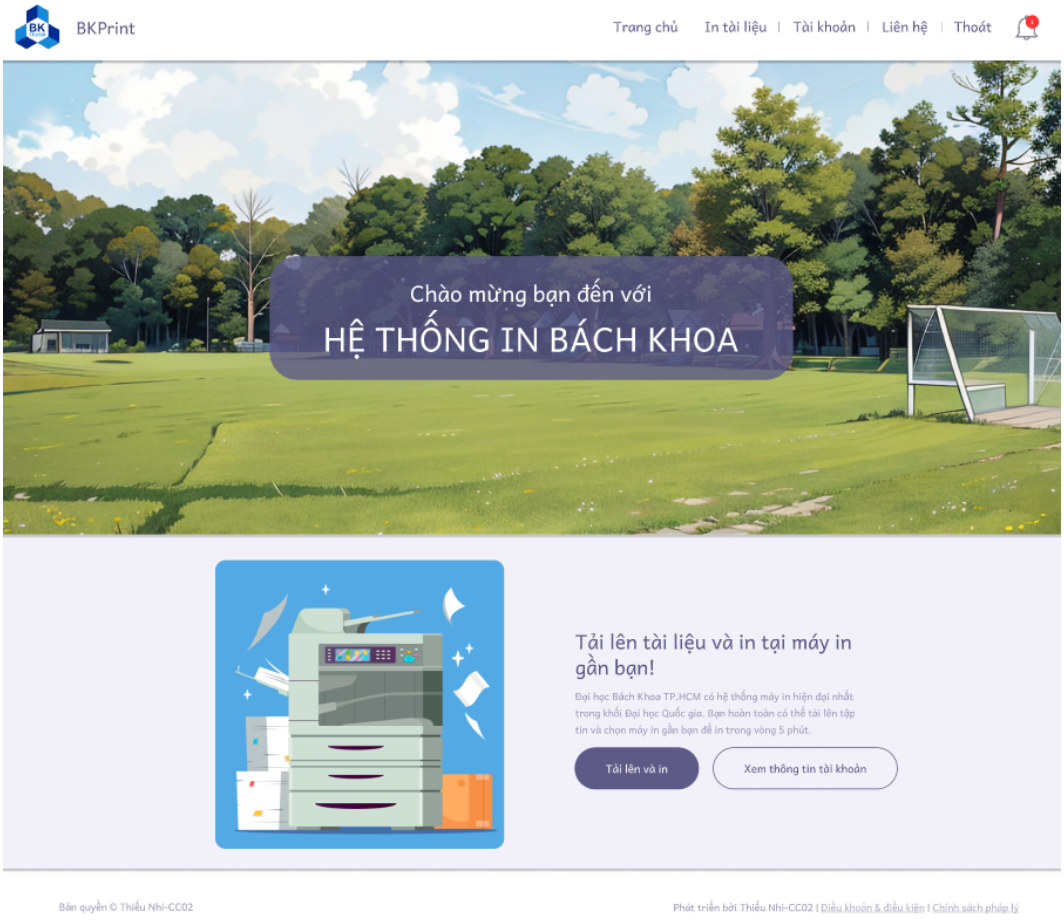
Hình 7: This is the Homepage where the user has not signed in yet.

Hình 8: After click "Đăng nhập", user has to choose whether they are students or admins

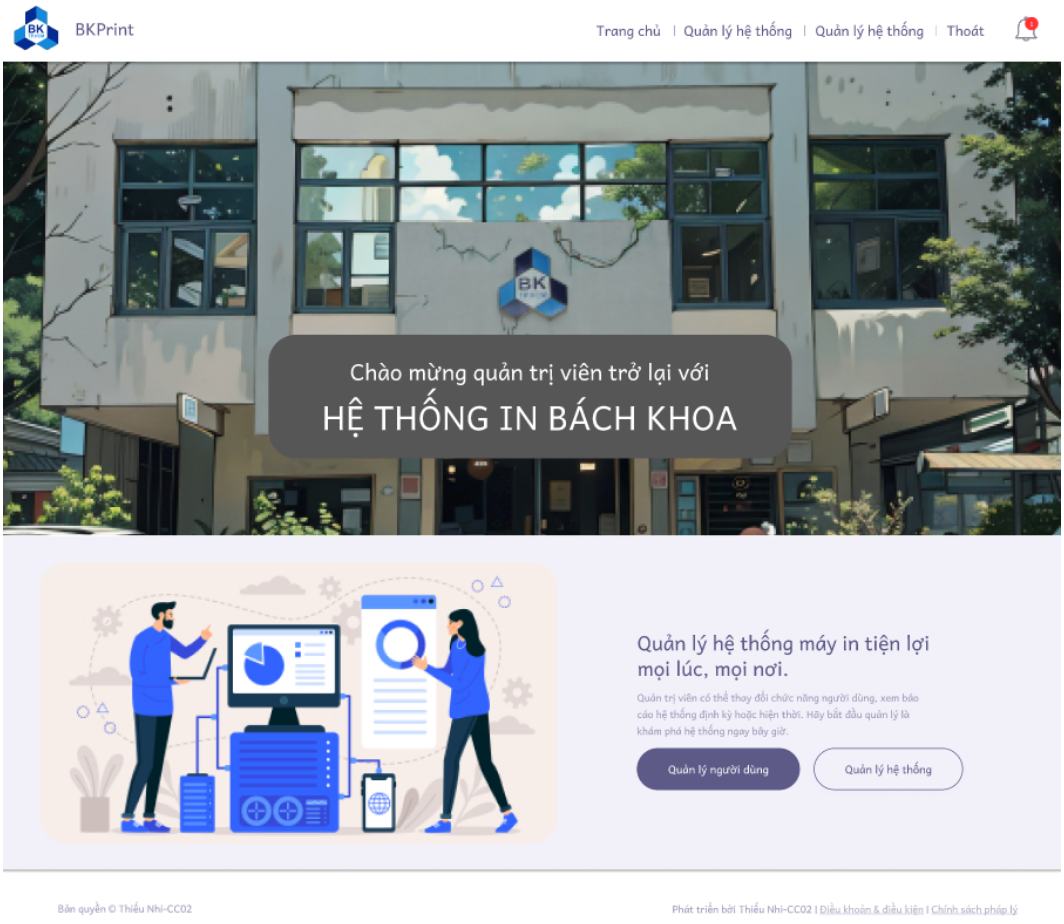
Hình 9: Student log in page



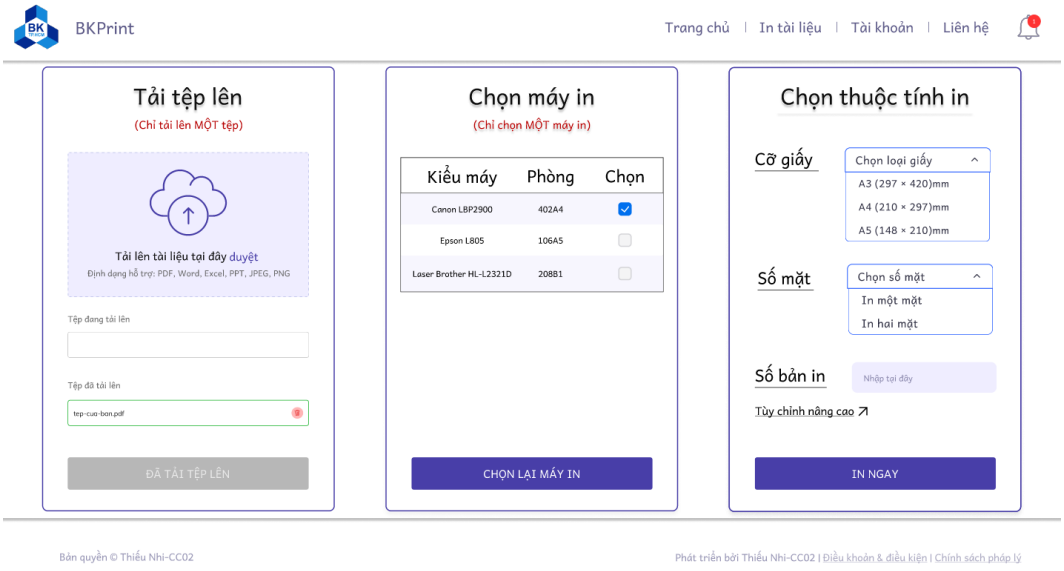
Hình 10: Admin log in page



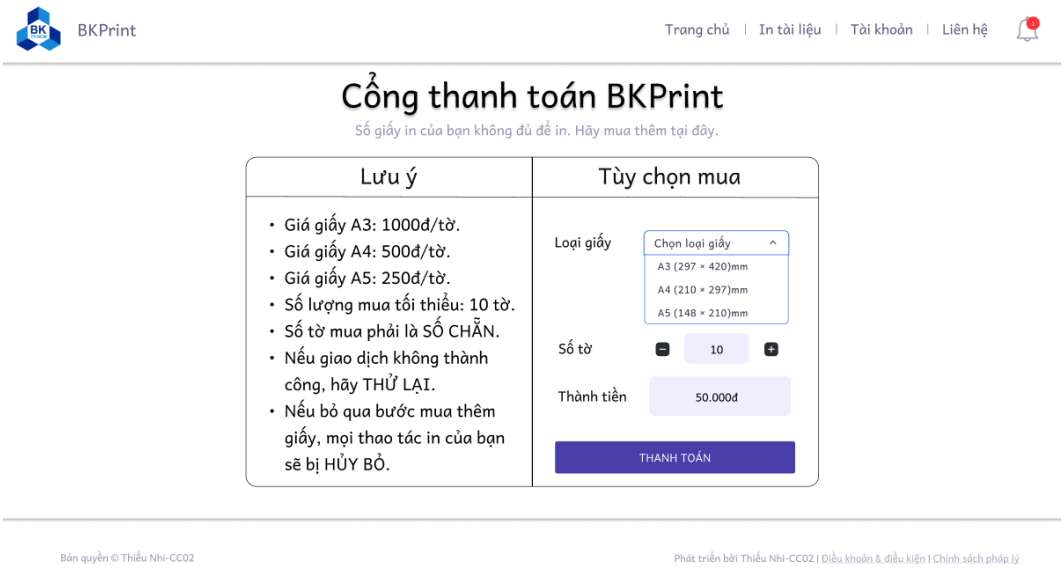
Hình 11: Student homepage after log in



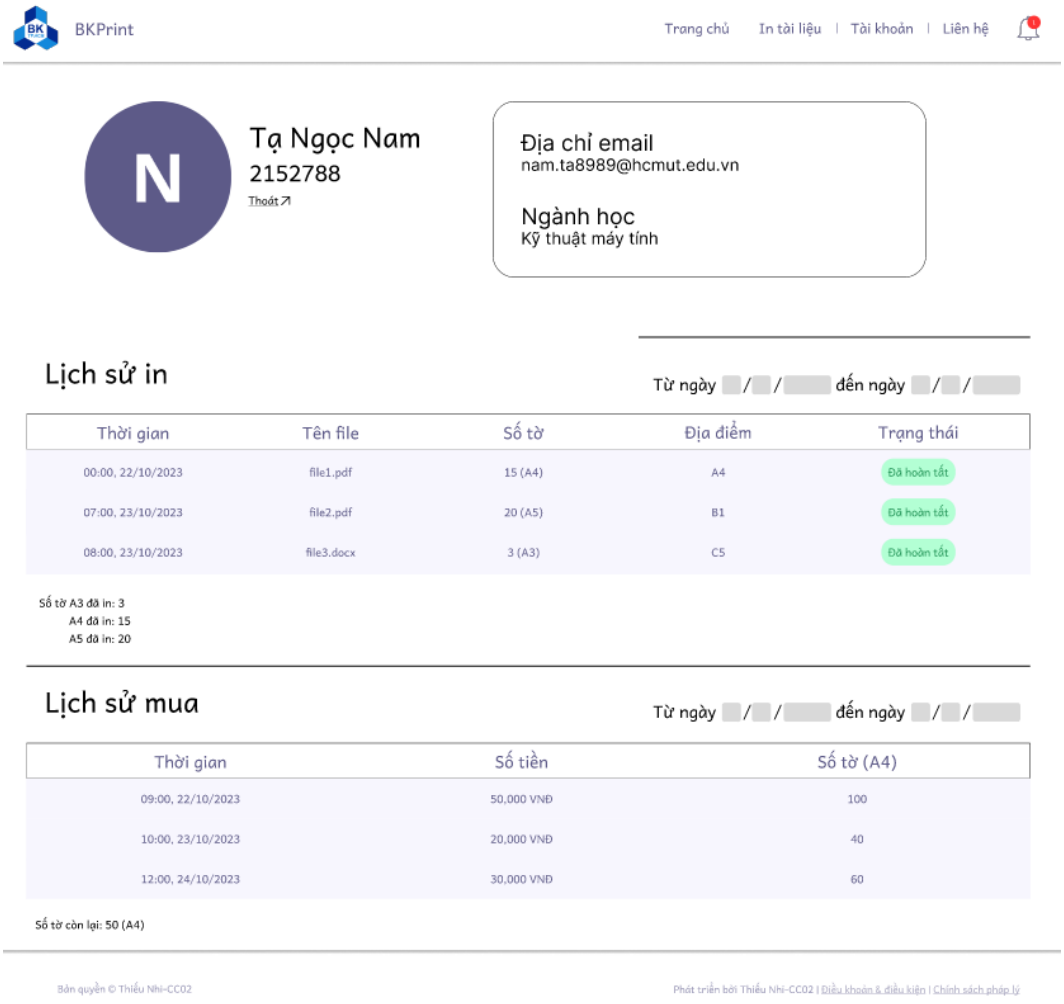
Hình 12: Admin homepage after log in



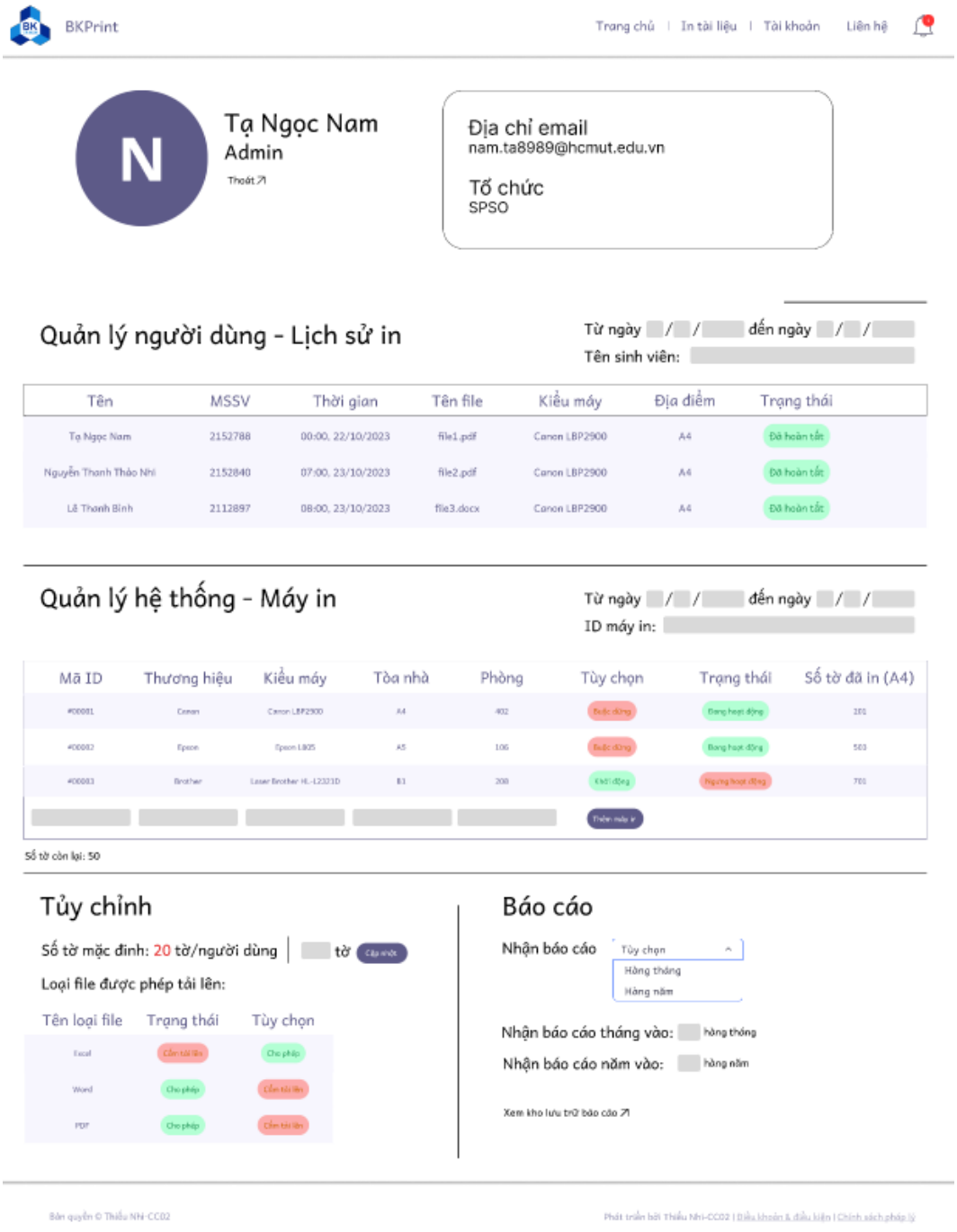
Hình 13: These are three phases of a printing process. Students are suposed to implement step by step.



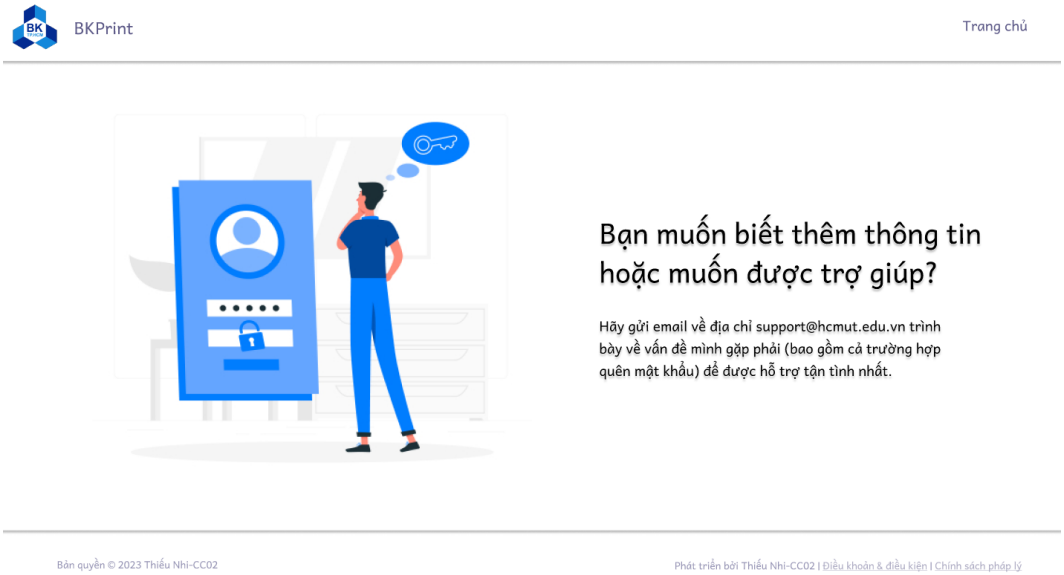
Hình 14: If the balance of the user is not efficient (not enough paper), the interface will redirect to this "buying page".



Hình 15: Student account page



Hình 16: Admin account page



Hình 17: If any error happens (such as user forgot their password, ...), they will be redirected to this page

As mentioned above, these images are just the general explanation. Please take a look at our UI design for better insight. Full UI wireframe design can be view at the link: CC02_Thiếu Nhi_Wireframe. The web demo of website can be viewed by clicking the "Present" button or pressing "Shift + Space".

6 Conclusion

This Modeling Document serves as a central repository for visual models and UI representations, providing a multi-dimensional understanding of the system. By incorporating diverse notations, diagram types, and UI wireframes, the document serves as a guiding reference for system architects, developers, and stakeholders. This comprehensive resource is essential for ensuring a smooth and efficient development process for the BKPrint system.