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UNIVERSITY OF TECHNOLOGY  
FACULTY OF COMPUTER SCIENCE AND ENGINEERING



## SOFTWARE ENGINEERING (CO3001)

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### Assignment Report

## SMART PRINTING SYSTEM

Semester 231 - Class CN01

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## Introduction

In this project, our group will implement **SMART PRINTING SYSTEM** system, which aims to make printing files more convenient for students. This project will benefit the users as well as us, as we have a better insight into the sequence of building an app from scratch, which is an essential aspect in Software Engineering.

### 1 Task 1: Requirement elicitation

#### 1.1 Domain context & Stakeholder

##### 1.1.1 Domain context

Printing is one of the most essential activities for university students. However, traditional printing methods have proven to be inconvenient as accessing data at the local store is a cumbersome task, while also insecure due to the security risk of printing files being sent to the store. Capitalizing on the recent advancements in the Internet of Things (IoT) field, we - Ho Chi Minh University of Technology (HCMUT) students - as pioneers can confidently implement a new cutting-edge system to resolve nowadays problems in printing. This innovative system promises to bring users convenience and effectiveness, ensuring the security of important printing papers while providing students an intuitive and user-friendly interface.

##### For HCMUT students:

HCMUT students, in general, often have to invest a significant amount of time and effort just to access basic services like document photocopying. For example, students usually need to walk across the relatively large campus to reach the parking lot, and then they have to use a bicycle or even walk to the printing service. The traditional approach, such as standing in line and waiting at the photocopy shop to obtain necessary documents or copies, can be time-consuming and make you feel uncomfortable. These factors make the need for these services and systems apparent.

##### For the SPSO (Officer responsible for Printer Maintenance):

As the party responsible for managing and maintaining printers at our school, introducing a new printing service raises several concerns. Among these is the need for careful monitoring of printer usage, including user identification, usage timing, and printed content. This requirement is crucial not only for optimizing resource allocation but also for promoting responsible environmental practices within our academic community. In addition, paper consumption should be kept in check in order to prevent damage to the environment. Through a comprehensive approach to printer management, our goal is to strike a balance between providing convenient printing services and conserving valuable resources. This dual objective will undoubtedly contribute to the development of an efficient and environmentally conscious printing ecosystem on our campus.

##### 1.1.2 Stakeholders

In the scope of our project, there would be three stakeholder groups included. Firstly, **HCMUT students** will have our utmost attention. This system aims to provide students with overall cheaper cost for printing (free limited amount of printing papers each semester), better accessibility (easier to upload files and delivery) and stronger security for their files. Secondly, **Smart Printing System Officers (SPSOs)** would have a smaller impact on our projects. SPSOs may be a student-driven departments, as they share the same goals with the students by maintaining, supervising the status of the printers and configuring the paper limit. This will reduce the fees of hiring multiple supervisors or managing student



printing information. Finally, our last stakeholder would be the **University** itself. The University doesn't gain much from this beside making profit from leasing printing machines, extra papers fee, etc. On the other hand, implementing this system can help securing private school materials from being leaked to outside printing stores.

#### 1.1.3 Stakeholders' benefits

Each stakeholders taking part in this project will have their respective benefits. Firstly, **the students** would benefit from this the most. They can save money by keeping their printing in the limited amount given each semester and manage their time better with time-saving features of the system. Moreover, the system ensures the privacy of their printed contents. Secondly, **the SPSOs** can adjust the paper limit, maintain the printers and analyze printing trends to further optimize the system and improve the user's experience overall, to which end they will create a safe and functional work environment for both the users and themselves. Finally, **the University** can use the analyzed data from SPSOs to reduce the cost for system maintenance. Furthermore, this is an opportunity for the University to collaborate with printing companies who will provide materials and equipment in exchange for technical supports and more business offers in the future. Overall, this system will help more university students print their files on time.

## 1.2 Functional and Non-functional Requirements

### 1.2.1 SSPS Functional Requirements

- **For the students using the SSPS service:**

- Register an account using HCMUT\_SSO authentication.
- Upload documents for printing, with printer selection and printing preferences.
- View printing history and page usage summary.
- Purchase additional printing pages through an online payment system.
- Receive notifications related to printing actions and account balance.

- **Student Printing Service Officer (SPSO):**

- Manage printers, including adding, enabling, or disabling them.
- Configure system settings, such as default page limits, permitted file types, and distribution dates.
- View and export system reports on usage and finances.

### 1.2.2 SPSS Non-functional Requirements

- **Requirements for system performance:**

- The system should be able to handle a maximum number of 250 incoming requests at the same time and 1000 request in an hour.
- The system can handle 250 sql queries per second
- Delay of a response after a request has to be less than 2 seconds.

- **Requirements for system usability:**



- The displayed language of the system is Vietnamese.
- The users should be able to navigate and use the service for their first time using the system within 3 clicks.

- **Requirements for system security:**

- Log in and log out the system using HCMUT\_SSO authentication.

- **Requirements for system reliability:**

- The system should be available from 4 a.m. to 8 p.m. everyday.
  - The system should have a failure rate of at most 2%.

- **Requirements for system compatibility:**

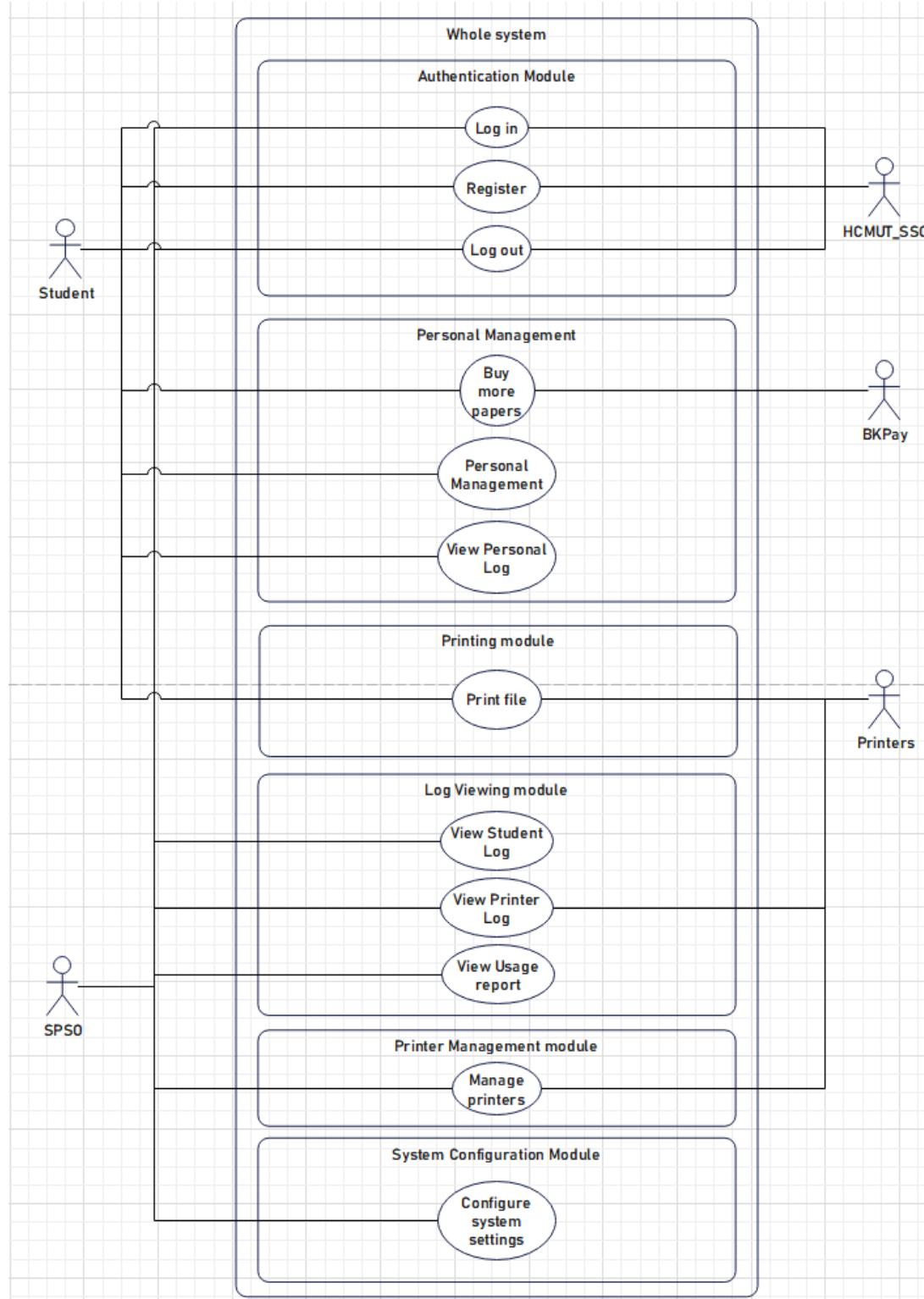
- The system should have the same interface and behaviors on different browsers Google Chrome, Internet Explorer, Safari with their respective latest version.

- **Requirements for system development:**

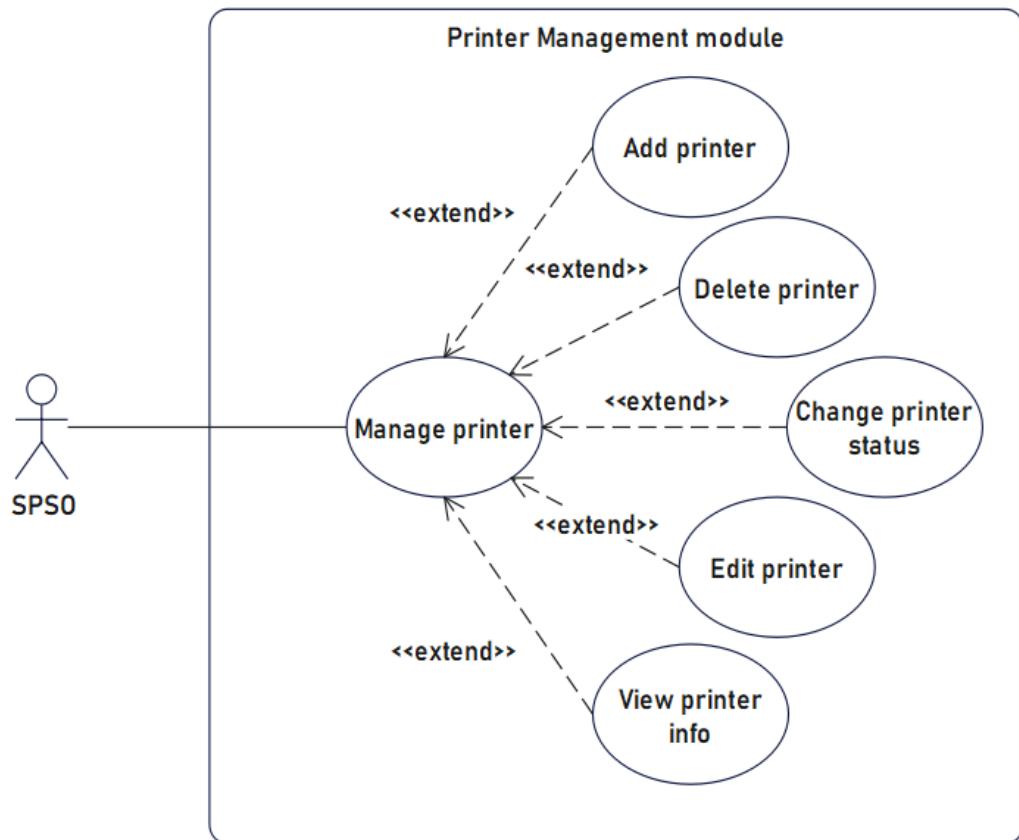
- The system should be written in HTML and CSS.
  - The system should use NodeJS, VueJS, ExpressJS as frameworks.
  - The system should use MongoDB to store data.

### 1.3 Use-case diagram

#### 1.3.1 Use-case diagram for whole system



### 1.3.2 Printer Management module



**Table 1:** Printer Management use-case description

Use-case ID	PM01
Use-case Name	Manage Printer
Actor	SPSO
Description	The SPSO wants to do some management with the available printer or add a new printer
Preconditions	The SPSO has an account and logged in.
Postconditions	The SPSO knows more info about the available printers The SPSO can do management about the printers
Triggers	The SPSO press the "Printers" in the navigation tab.
Normal Flow	<ol style="list-style-type: none"> <li>1. The SPSO requests to manage the printers.</li> <li>2. The system sends a list of existing printers, with each printers in the list has 4 buttons: "Details", "Enable" or "Disable" based on its current status, "Delete", "Edit" and the printer's status. The page also have an "Assign" button on top of the list.</li> <li>3. The SPSO selects a button.</li> <li>4. The system update the list in response to the change.</li> </ol>
Exceptions	None
Alternative Flows	None
Extension Points	<p>3a1. The SPSO selects the "Assign" button  <i>Use case PM01-Extend-C starts</i></p> <p>3b1. The SPSO selects the "Details" button of one printer  <i>Use case PM01-Extend-R starts</i></p> <p>3c1. If the SPSO pressed the "Enable" button corresponding to a disabled printer.  <i>Use case PM01-Extend-ED starts</i></p> <p>3d1. If the SPSO pressed the "Disable" button corresponding to an enabled printer.  <i>Use case PM01-Extend-ED starts</i></p> <p>3e1. If the SPSO pressed the "Delete" button corresponding to a printer.  <i>Use case PM01-Extend-D starts</i></p> <p>3f1. If the SPSO pressed the "Edit" button corresponding to a printer.  <i>Use case PM01-Extend-U starts</i></p>

**Table 2:** Printer Management use-case description

Use-case ID	PM01-Extend-C
Use-case Name	Add Printer
Actor	SPSO
Description	The SPSO wants to assign a new printer
Preconditions	The SPSO has an account and logged in. The SPSO has requested to add a new printer from the list page.
Postconditions	The system updates the list with the new printer
Triggers	The SPSO press the "Assign" button in the Printer Management page.
Normal Flow	<ol style="list-style-type: none"> <li>1. The SPSO requests to add a new printer.</li> <li>2. The system sends a form asking for the printer's information.</li> <li>3. The SPSO fills in necessary information.</li> <li>4. The SPSO confirms the form.</li> <li>5. The system validates the information.</li> <li>6. The system adds a new printer as enabled into the list, notifies the SPSO about the success and redirects to the list page.</li> </ol>
Exceptions	<p>2a1. If the SPSO cancel the form, then they will be back in the Printer Management page.</p> <p>5a1. If the validation returns false, the SPSO is prompt to refill the form.</p> <p><i>The use case continues at step 3</i></p>
Alternative Flows	None
Extension Points	None

**Table 3:** Printer Management use-case description

Use-case ID	PM01-Extend-R
Use-case Name	View Printer Info
Actor	SPSO
Description	The SPSO wants to see the printer's information
Preconditions	The SPSO has an account and logged in. The SPSO has requested to view a printer's information from the list page.
Postconditions	The SPSO can see the printer's information
Triggers	The SPSO press the "Details" button in the Printer Management page.
Normal Flow	<ol style="list-style-type: none"> <li>1. The SPSO requests to view the printer.</li> <li>2. The system gets the printer's information from the database.</li> <li>3. The system shows the printer's information.</li> </ol>
Exceptions	None
Alternative Flows	None
Extension Points	None

**Table 4:** Printer Management use-case description

Use-case ID	PM01-Extend-ED
Use-case Name	Change printer status
Actor	SPSO
Description	The SPSO wants to change the printer status
Preconditions	The SPSO has an account and logged in. The SPSO has requested to change the status of a printer.
Postconditions	The system change the corresponding printer status
Triggers	The SPSO press the "Enable"/"Disable" button in the Printer Management page.
Normal Flow	<ol style="list-style-type: none"> <li>1. The SPSO requests to enable/disable a printer via pressing the button.</li> <li>2. The system prompts the SPSO to reconfirm.</li> <li>3. The SPSO reconfirms.</li> <li>4. The system changes the corresponding printer status and show a success message and update the list.</li> </ol>
Exceptions	3a1. If the SPSO cancel this request, then they will be back in the Printer Management page.
Alternative Flows	None
Extension Points	None

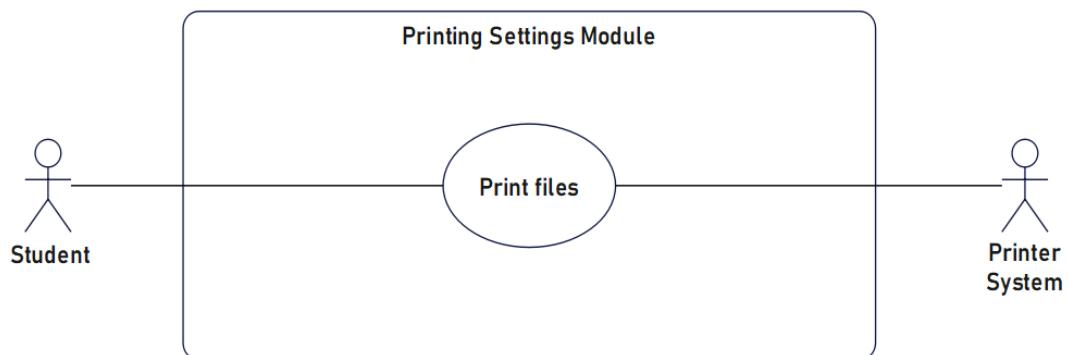
**Table 5:** Printer Management use-case description

Use-case ID	PM01-Extend-U
Use-case Name	Edit printer
Actor	SPSO
Description	The SPSO wants to edit the printer information
Preconditions	The SPSO has an account and logged in. The SPSO has requested to edit the printer information.
Postconditions	The system update the printer new information
Triggers	The SPSO press the "Edit" button in the Printer Management page.
Normal Flow	<ol style="list-style-type: none"> <li>1. The SPSO requests to edit a printer via pressing the button.</li> <li>2. The system sends a form consisting of the printer current information and ask the SPSO to change it.</li> <li>3. The SPSO revises the information they wanted to change.</li> <li>4. The SPSO submits the form.</li> <li>5. The system validates the form.</li> <li>6. The system updates the corresponding printer information and show a success message and update the list.</li> </ol>
Exceptions	<p>2a1. If the SPSO cancel the form, then they will be back in the Printer Management page.</p> <p>5a1. If the validation returns false, the SPSO is prompt to refill the form.</p> <p><i>The use case continues at step 3</i></p>
Alternative Flows	None
Extension Points	None

**Table 6: Printer Management use-case description**

Use-case ID	PM01-Extend-D
Use-case Name	Delete printer
Actor	SPSO
Description	The SPSO wants to delete a printer entity
Preconditions	The SPSO has an account and logged in. The SPSO has requested to delete a printer.
Postconditions	The system delete that printer out of the list
Triggers	The SPSO press the "Delete" button in the Printer Management page.
Normal Flow	<ol style="list-style-type: none"> <li>1. The SPSO requests to delete a printer via pressing the button.</li> <li>2. The system prompts the SPSO to reconfirm.</li> <li>3. The SPSO reconfirms.</li> <li>4. The system changes the corresponding printer status and show a success message and update the list.</li> </ol>
Exceptions	3a1. If the SPSO cancel this request, then they will be back in the Printer Management page.
Alternative Flows	None
Extension Points	None

### 1.3.3 Printing Settings module



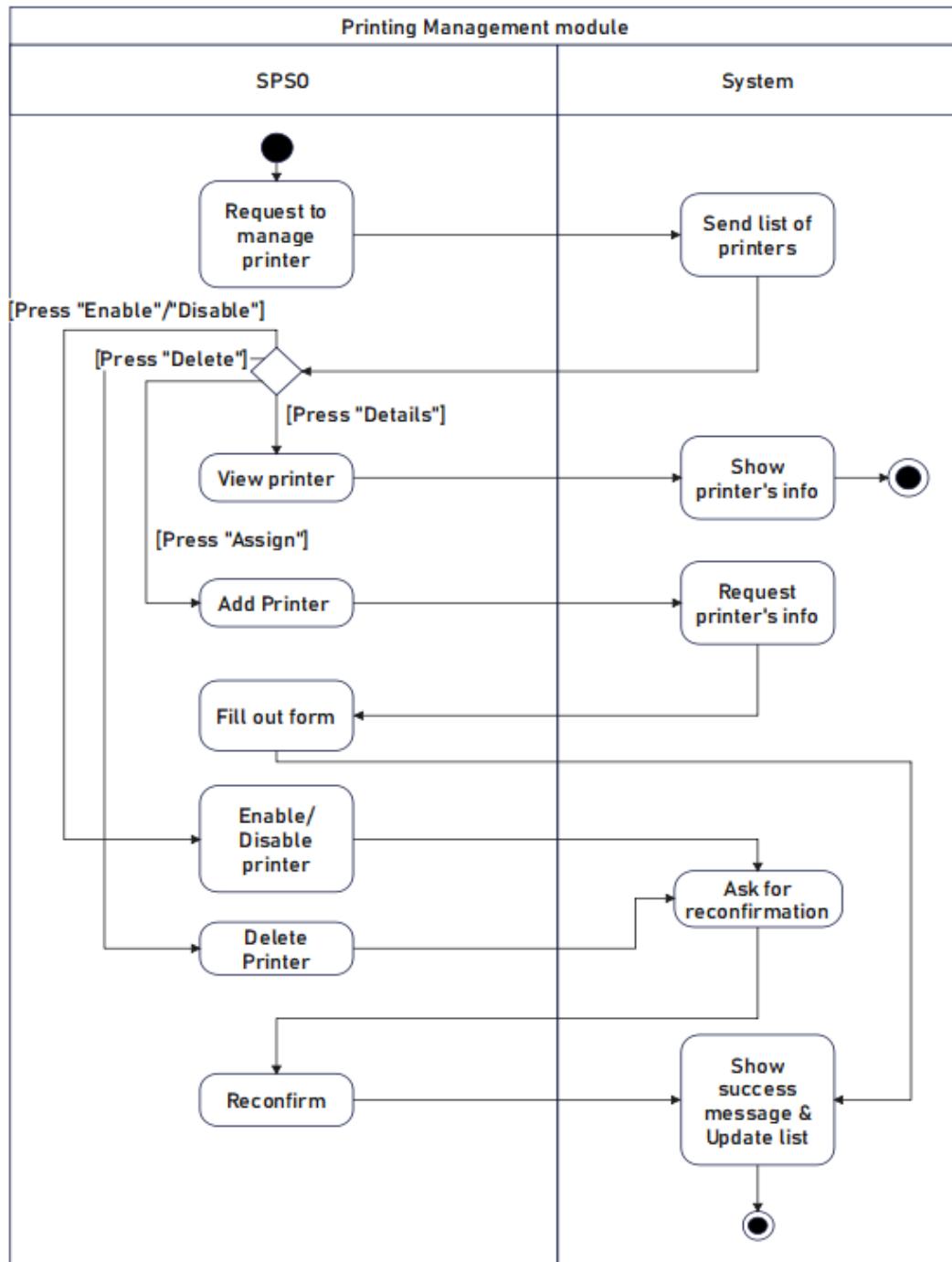
**Table 7:** Printing Settings use-case description

Use-case ID	PS01
Use-case Name	Print Files
Actor	Student
Description	The student wishes to print their files
Preconditions	The student has an account and logged in. The student still have remaining paper to print.
Postconditions	The student get their papers printed. The system deduce the student's remaining paper count.
Triggers	The student press the "Print" button. The student press the "Print" in the navigation tab.
Normal Flow	<ol style="list-style-type: none"> <li>1. The student requests for printing.</li> <li>2. The system prompts the student to submit the document.</li> <li>3. The student submits the document.</li> <li>4. The system validates the file type and display a form and a preview about the printing paper.</li> <li>5. The student selects their desired printer (which will also show its current queue and estimated waiting time), and fill the form with their desired printing options and paper size.</li> <li>6. The student submits the form.</li> <li>7. The system validates the form, and deduce the amount of papers of the student.</li> <li>8. The system signals the designated printer to print out the paper.</li> <li>9. The printer notifies the student when the printing is finished.</li> </ol>
Exceptions	<p>4a1. If the student uploaded the wrong file type, the system will appear a warning sign and ask the student to reupload.</p> <p><i>Use-case continues with step 3</i></p> <p>7a1. If the student doesn't have any paper count remain, the system will prompt the student to buy more paper via the personal page.</p>
Alternative Flows	None
Extension Points	None

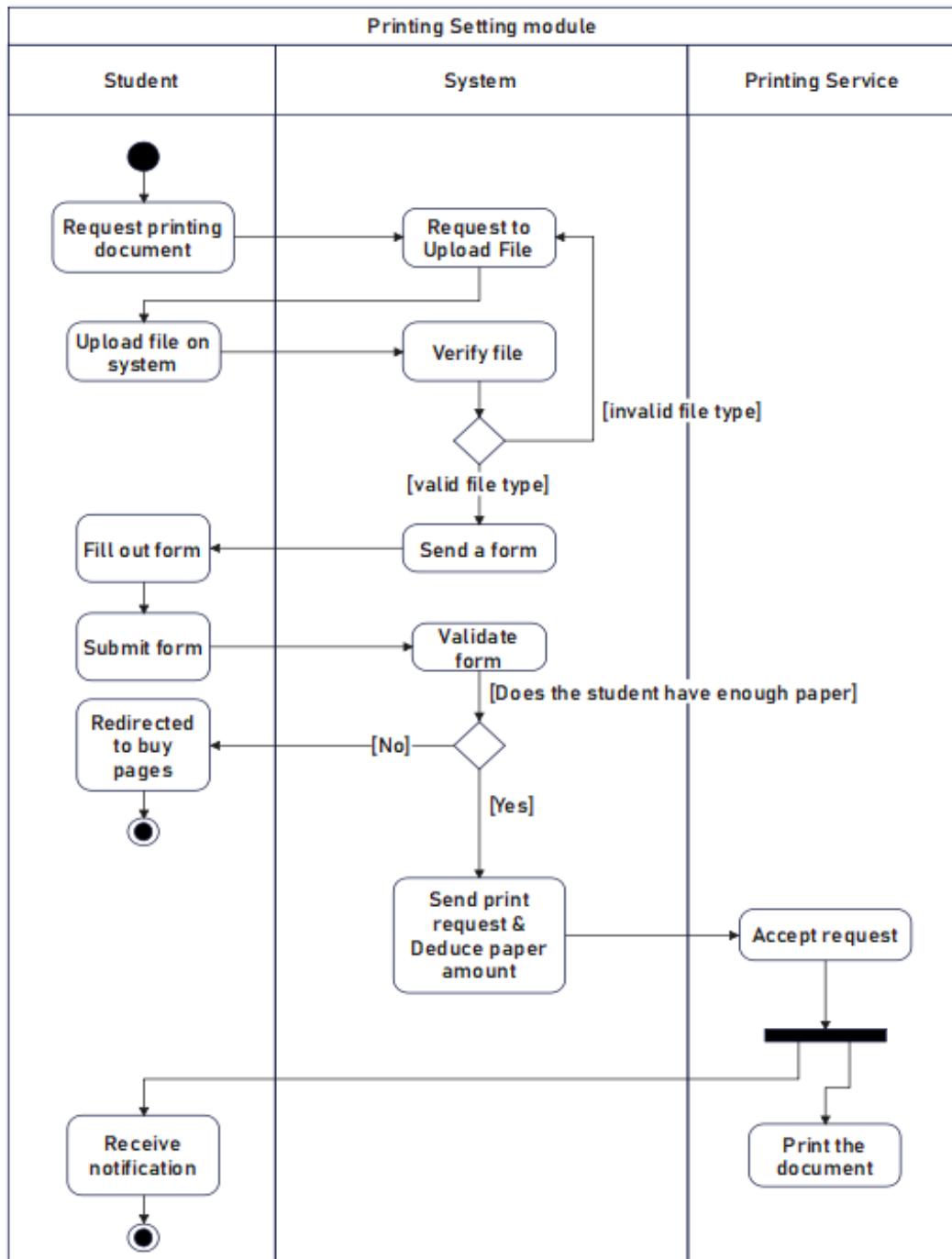
## 2 Task 2: System modelling

### 2.1 Activity Diagram

#### 2.1.1 Printer Management module

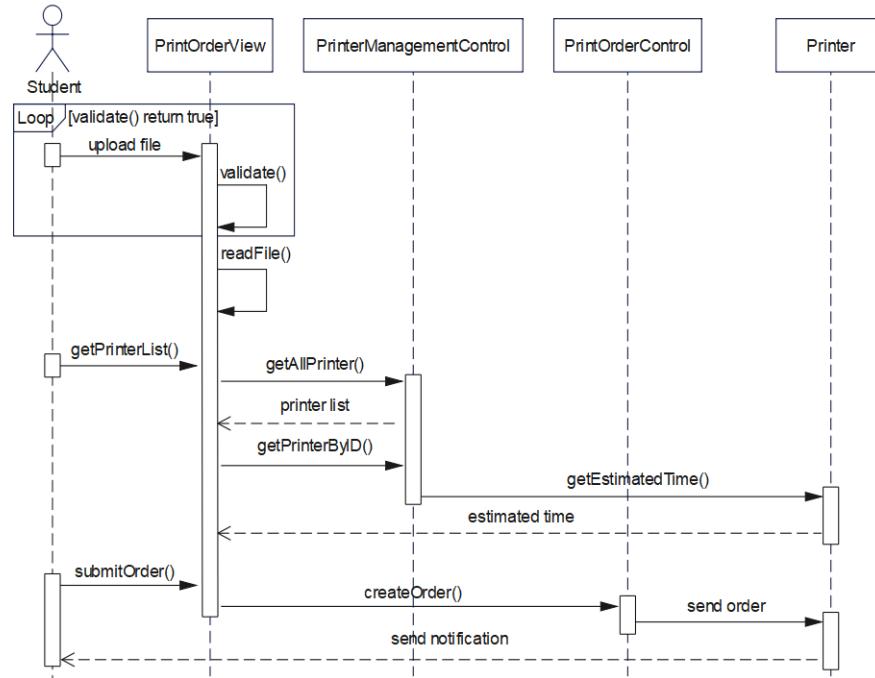


### 2.1.2 Printing Setting module



## 2.2 Sequence Diagram

### 2.2.1 Printing Setting module



**Figure 1:** Printing Setting sequence diagram

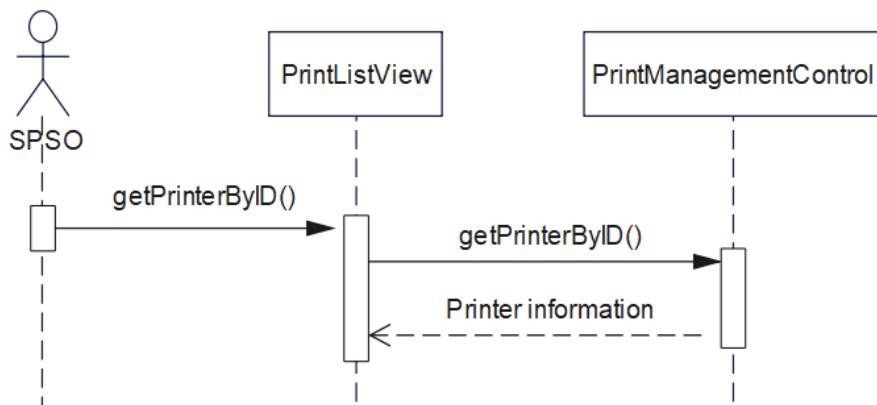
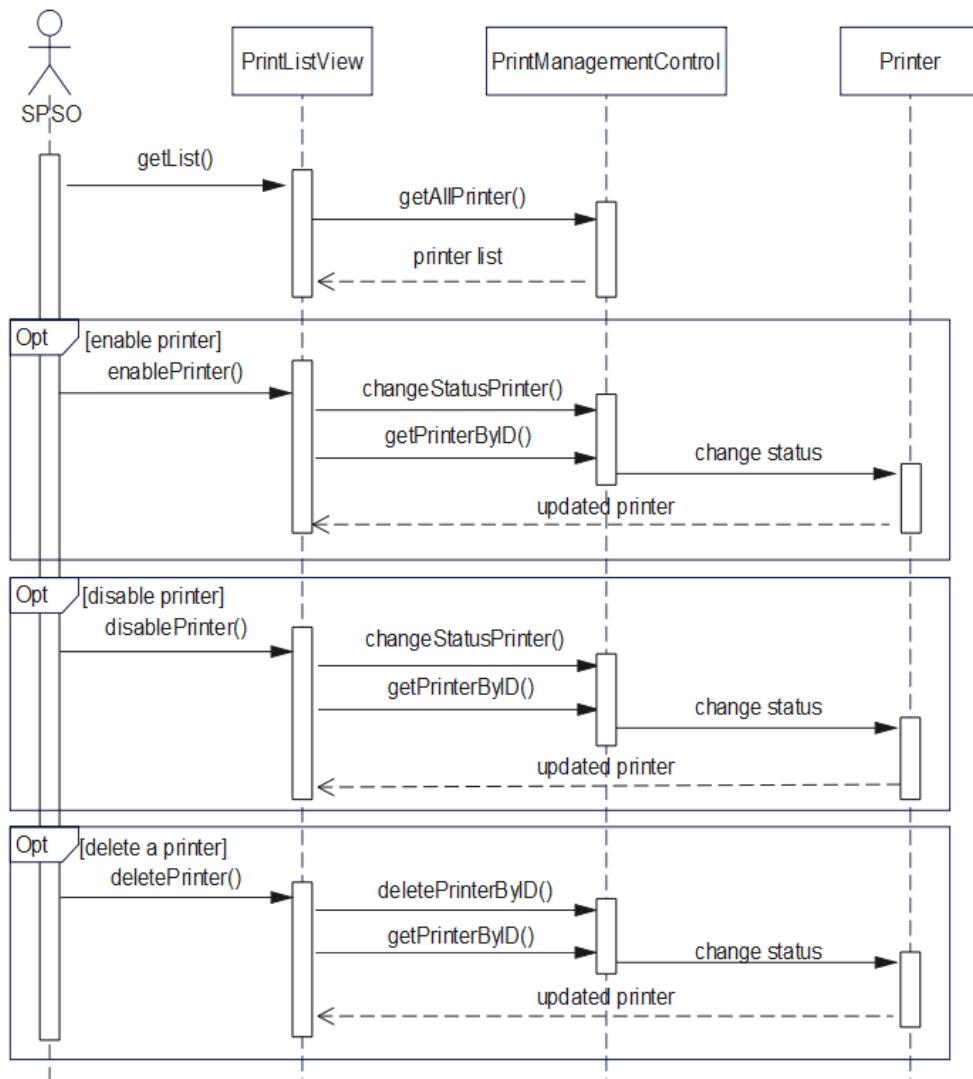
#### Student to System Interaction:

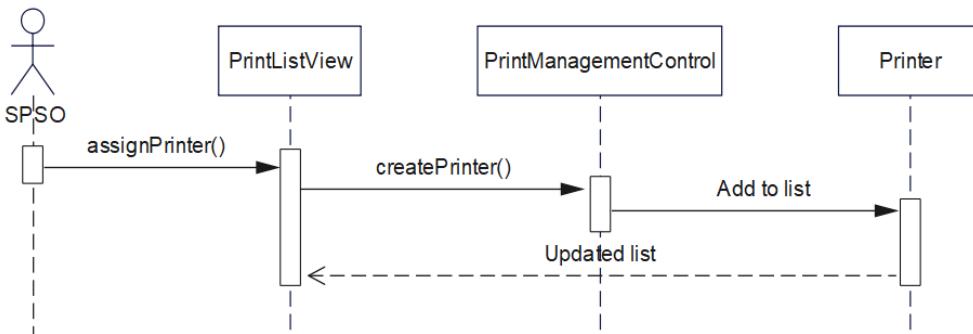
The process starts when the student requests the system to print a document. An alternative condition checks if the login session is decayed. If yes, the student is redirected to login. If not, the system proceeds to create a form. The student then performs a series of steps: Uploads the document they wish to print. Selects a printer. Changes any necessary printing options. Chooses the paper size. Confirms their choices. System Internal Check:

The system has another alternative condition that checks if the student has enough remaining papers (credits) for the print job. If not, the student is redirected to purchase more papers (credits). If the student has enough credits, the system validates the form. System to Printer Interaction:

Once the form is validated, the system sends a signal to the printer. The printer then prints the document as per the student's specifications. The sequence diagram visually represents the flow of events, decisions made based on conditions, and the interactions between the student, system, and printer. It helps in understanding the sequence of actions that occur from the moment a student decides to print a document until the document is printed by the printer.

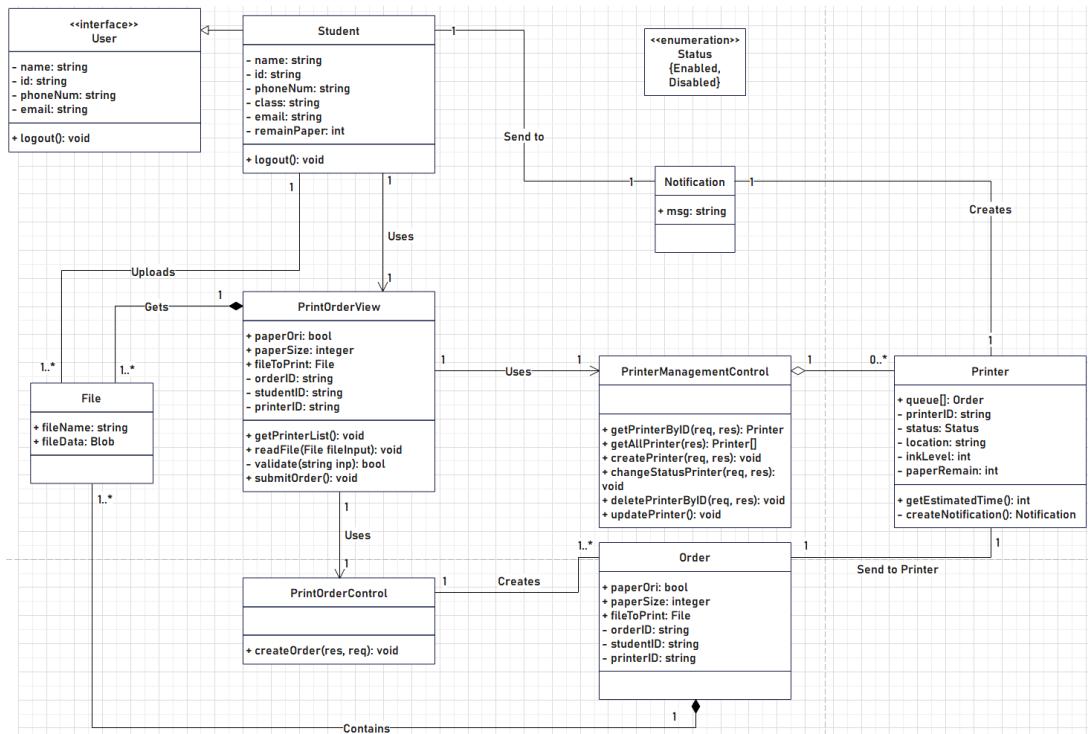
### 2.2.2 Printer Management module





## 2.3 Class Diagram

### 2.3.1 Printing Setting module



#### Basic User:

There's an interface named User with basic attributes like name, id, phoneNum, and email. It also defines methods for logging out. The Student class implements the User interface and has the same attributes with an additional class attribute representing the student's academic class or group.

#### File Upload:

Students can upload files, creating File objects. This class has attributes fileName and fileData which represent the name of the file and its content, respectively.

#### Create Print Request:

The main interaction is placing an order, represented by the Placing Order relationship. PrintOrderView is a UI that let students view and fill out their settings and create an Order. It has attributes like paperOri (paper orientation), paperSize, fileToPrint, orderId, studentID, and printerID. It has the "createOrder" function to create a request to the designated printer. This will create an Order object based on the

information it was fed.

#### Printer Interaction:

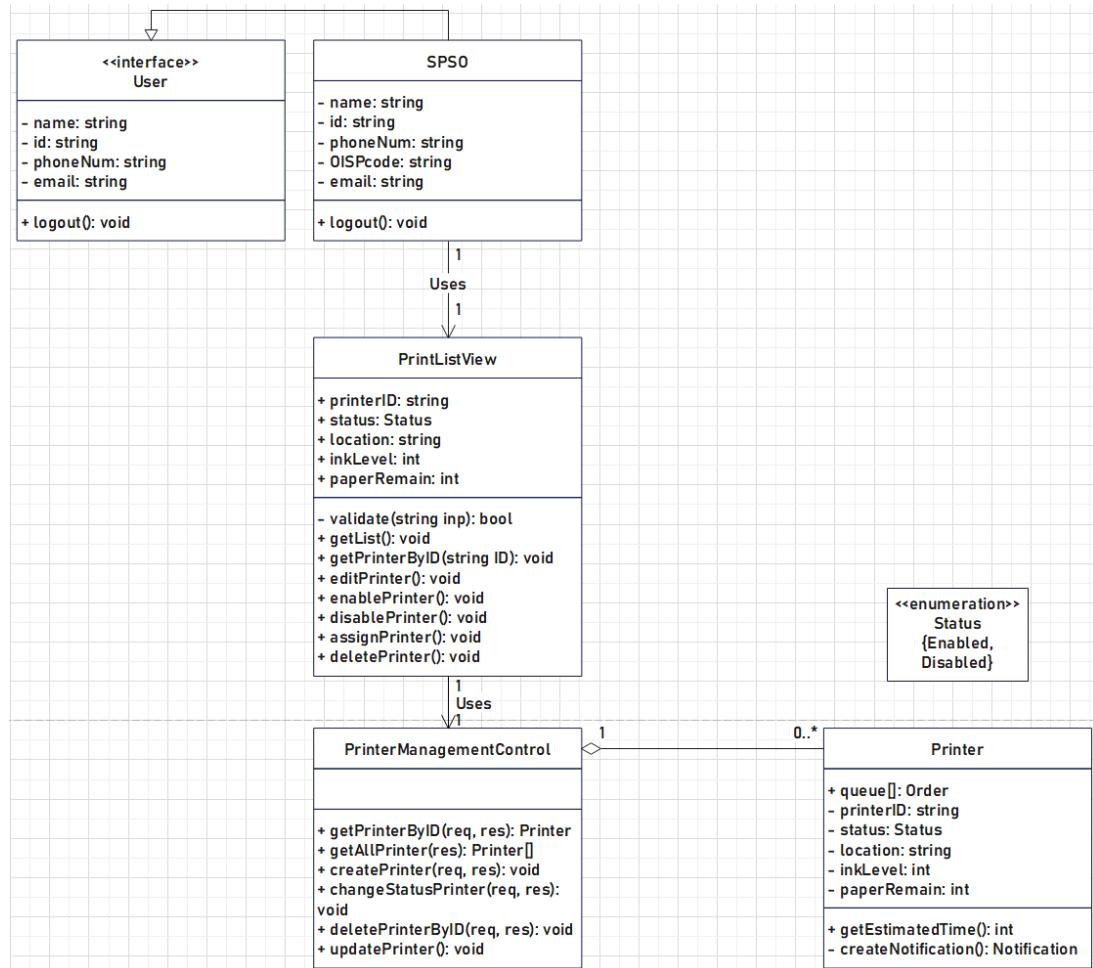
The printer has a queue of orders (queue[] of type Order) and a unique printerID. The getEstimatedTime() method will return the estimated time until this order will be taken care of. When a print request is finished, a Notification with a message (msg) is created and sent to that student.

#### Relationships and Cardinalities:

The diagram also shows the cardinalities and relationships between classes. For instance:

- A student can upload multiple files (1 to many).
- An order contains one file (1 to 1).
- A student can create multiple orders (1 to many).
- Printers can have multiple orders in their queue (array).

#### 2.3.2 Printer Management module



#### Basic User:

The SPSO class implements from the User interface with basic attributes like name, id, phoneNum, and email, logout(), and with the addition of OISPcode for unique identification.

#### Management:

SPSO use the UI represented by the PrintListView object to do basic work like view printer's info, enable/disable a printer, assign a new printer or delete an existing printer via the respective functions.



## PrinterList

The system also keep in track a list of existing Printer, which can return a Printer if needed, or append a new one when using assignPrinter().

### Relationships and Cardinalities:

The diagram also shows the cardinalities and relationships between classes. For instance:

- The UI Object keep track of the list (1 to 1).
- The PrinterList object can keep track of all of the printers even when there are none (1 to many).

## 2.4 Wireframe

### 2.4.1 Printing Settings module

Log in, register and log out here

The wireframe shows a login interface for the Galacticos Smart Printing System. At the top, there is a navigation bar with links for Trang chủ, Giới thiệu, Đăng nhập, and Đăng kí. The main title "Galacticos" is displayed prominently in blue, with the subtitle "Smart Printing System" below it. The login form consists of two input fields: "Tài khoản" (Account) and "Mật khẩu" (Password), separated by a horizontal line. Below these fields is a "Remember me" checkbox. A large blue button labeled "Đăng nhập" (Login) is centered below the password field. To the left of the login button is a link "Quên mật khẩu?" (Forgot password?) and to the right is a link "Đăng kí" (Register). Below the login area, there is a note "hoặc có thể đăng nhập bằng" (Or log in using) followed by three social media icons: Google+, Facebook, and Quora. At the bottom of the page, there is a footer with links for "Bản quyền © 2023 Galacticos", "Hỗ trợ", "Điều khoản sử dụng", "Chính sách bảo mật", and "Liên hệ". On the far right of the footer is a small Vietnamese flag icon with the word "Vietnam".



The student start at the homepage.

The screenshot shows the Galacticos homepage with the following sections:

- Header:** Galacticos, Trang chủ, Giới thiệu, Máy in, In tài liệu, Đơn in, Đóng góp, User icon.
- Printer Status:** A list of printer statuses:
  - 12 giờ trước: Thông báo hệ thống. Printer #2 đã được thêm mực.
  - 15 giờ trước: Thông báo hệ thống. Printer #1 đã được thêm giấy.
  - 18 giờ trước: Thông báo hệ thống. Printer #2 đã hết mực in.
  - 1 ngày trước: Thông báo hệ thống. Printer #1 đã hết giấy in.
- In tài liệu:** You have 8 pages ready. A button to "Buy more paper".
- Mua thêm giấy?** You need to buy paper to print documents. A button to "View documents".
- Xem đơn in?** You have 4 pending prints.
- Bạn muốn đóng góp?** Contribute to receive paper. A button to "Contact admin".
- Footer:** Copyright © 2023 Galacticos, Help, Terms of service, Privacy policy, Contact, Vietnamese flag, Vietnam.



Clicking the user icon in the navigation bar will allow the user to view their user's history, storage, statistic as well as changing their account settings.

The screenshot shows the Galacticos website with a user profile on the right. The profile picture is a blue silhouette of a person, and the name is 'AkaneLink' with the title 'Sinh viên'. Below the profile are three icons: a clock labeled 'Lịch sử', a folder labeled 'File đã lưu', and a pie chart labeled 'Thống kê'. At the bottom of the profile section are two buttons: 'Cài đặt' and 'Đăng xuất'. On the left, there is a list of system notifications:

- 12 giờ trước: Thông báo hệ thống - Printer #2 đã được thêm mục.
- 15 giờ trước: Thông báo hệ thống - Printer #1 đã được thêm mục.
- 18 giờ trước: Thông báo hệ thống - Printer #2 đã hết mực in.
- 1 ngày trước: Thông báo hệ thống - Printer #1 đã hết giấy in.
- 7 ngày trước: 1 người dùng đã đăng Hướng dẫn sử dụng website | Dev Team. Includes a short lorem ipsum text and a link to the post.

At the bottom of the page are links for 'Bản quyền © 2023 Galacticos', 'Hỗ trợ', 'Điều khoản sử dụng', 'Chính sách bảo mật', 'Liên hệ', and the Vietnamese flag with the word 'Vietnam'.

After either clicking Print button in the upper right box or on the navigation bar, the printing process will be started.

The screenshot shows the 'In tài liệu' (Print document) page. The main heading is 'In tài liệu' with the sub-instruction 'Lựa chọn tài liệu mà bạn muốn in'. Below this is a large dashed rectangular area for file upload, with buttons 'Tải file lên' and 'thả file ở đây'. To the left, there is a section titled 'Trang web in ấn online' with the following text:

Ứng dụng web này rất tiện lợi khi bạn cần in một tệp tài liệu. Nó không yêu cầu cài đặt và hoạt động trực tiếp trên trình duyệt của bạn.

To the right, there are three sections: 'Tính bảo mật cao' (High security), 'Dễ dàng sử dụng' (Easy to use), and 'Trang web in ấn online' (Online print website). The 'Tính bảo mật cao' section states: 'Các tệp của bạn sẽ được xóa khỏi máy chủ của ứng dụng vài giờ sau khi thực hiện việc in ấn. Không ai có quyền truy cập vào chúng trừ bạn..'. The 'Dễ dàng sử dụng' section states: 'Ứng dụng sử dụng giao diện thân thiện với người dùng, với hướng dẫn dễ đọc và được tích hợp các thao tác rất đơn giản.' At the bottom are links for 'Bản quyền © 2023 Galacticos', 'Hỗ trợ', 'Điều khoản sử dụng', 'Chính sách bảo mật', 'Liên hệ', and the Vietnamese flag with the word 'Vietnam'.



At this page, they are prompted to upload their desired document to print by using the upload button or drag and drop the file here. Afterward, they are greeted with the Print Preview page to let them know how their paper would look like after printing. They should select which printer to carry out this request.

Bản xem trước

**TITLE**

Chỉnh sửa thông số cho bản in

Chọn máy in

Số bản:  Bố cục:

Trang in:  Kiểu in:

Cỡ giấy:  Số trang mỗi mặt:  Tỉ lệ:

Bạn hiện có 40 trang để in.

In

Bản quyền © 2023 Galacticos | Hỗ trợ | Điều khoản sử dụng | Chính sách bảo mật | Liên hệ | Vietnam

Should the remaining papers are not enough to proceed, the Print button will be locked and the user can't print the file.

Bản xem trước

**TITLE**

Chỉnh sửa thông số cho bản in

Chọn máy in

Số bản:  Bố cục:

Trang in:  Kiểu in:

Cỡ giấy:  Số trang mỗi mặt:  Tỉ lệ:

Bạn hiện có 0 trang để in.

In

Bản quyền © 2023 Galacticos | Hỗ trợ | Điều khoản sử dụng | Chính sách bảo mật | Liên hệ | Vietnam



A successful order will display a thank you message and allow the user to return to the homepage.

The screenshot shows a landing page for printing services. At the top, there's a navigation bar with links to Galacticos, Trang chủ, Giới thiệu, Máy in, In tài liệu, Đơn in, and Đóng góp. A user profile icon is also present. The main title is "In tài liệu" (Print Materials), followed by a sub-headline "Cảm ơn vì đã lựa chọn dịch vụ của chúng tôi" (Thank you for choosing our service). Below this, a note says "Lời nhắc: Bạn có thể truy cập vào trang Đơn in để theo dõi các đơn đặt in của bạn." (Reminder: You can access the Order page to track your printing orders). A blue button labeled "Quay lại màn hình chính" (Return to main screen) is visible. The page is divided into several sections: "Trang web in ấn online" (Online printing website), "Tính bảo mật cao" (High security), "Dễ dàng sử dụng" (Easy to use), "Đa dạng về cài đặt" (Various setup options), "Đa dạng về loại tập tin" (Various file types), and "Truy cập mọi nơi" (Access from anywhere). At the bottom, there's a footer with links to "Bản quyền © 2023 Galacticos", "Hỗ trợ", "Điều khoản sử dụng", "Chính sách bảo mật", "Liên hệ", and the Vietnamese flag.

User can also view the orders they made by going to the Orders tab.

The screenshot shows the "Đơn in" (Print Orders) page. The title is "Đơn in" (Print Orders) with the subtitle "All of your printing orders in one place." Below the title are several filter buttons: "Định dạng tệp" (File format), "Tình trạng" (Status), "Máy in: 1, 2, 3...", "Khổ giấy: A4", and a search bar "Tìm kiếm". The main content area displays a table of pending print jobs. The columns are: Status, Máy in #, Tên file, Định dạng file, Khổ giấy, Due date. One job is listed: Status: 1, Máy in #: lorem\_ipsum, Tên file: .pdf, Định dạng file: A4, Due date: 15 - 12 - 2023. At the bottom, there are pagination controls "50 / Trang" (Page 50) and a set of numbered buttons for navigating through the pages (1, 2, 3, ..., 10). The footer includes links to "Bản quyền © 2023 Galacticos", "Hỗ trợ", "Điều khoản sử dụng", "Chính sách bảo mật", "Liên hệ", and the Vietnamese flag.



Orders are displayed in list under an assist bar where the user can filter out the orders they want.

The screenshot shows a list of print jobs with the following details:

File Type	Status	Printer	File Name	Print Format	Paper Size	Deadline
.doc	Hoàn thành	Printer #1	file1.doc	.pdf	A4	15 - 12 - 2023
.docx	Đang đợi	Printer #1	file2.docx	.pdf	A4	15 - 12 - 2023
.pdf	Hủy	Printer #1	file3.pdf	.pdf	A4	15 - 12 - 2023

Filtering options at the top include:

- Định dạng tệp: .doc, .docx, .pdf
- Tình trạng: Hoàn thành, Đang đợi, Hủy
- Máy in: 1, 2, 3...
- Khổ giấy: A4
- Tìm kiếm: lorem\_ipsum

Page navigation and other controls are also visible.

Selected filter options will be added under the assist bar and only matched orders will remain in the list.

The screenshot shows a list of print jobs with the following details, reflecting the applied filters:

File Type	Status	Printer	File Name	Print Format	Paper Size	Deadline
.pdf	Đang đợi	Printer #1	lorem_ipsum	.pdf	A4	15 - 12 - 2023

Filtering options at the top include:

- Định dạng tệp: .pdf
- Tình trạng: Đang đợi
- Máy in #: Printer #1
- Khổ giấy: A4
- Tên file: lorem\_ipsum
- Tìm kiếm: lorem\_ipsum

Page navigation and other controls are also visible.



Choosing an order will open the Order Review where the user can check their order information.

Screenshot of the 'In tài liệu' (Print document) page:

The page title is 'In tài liệu'. Below it is a sub-header: 'Xem cài đặt của bạn trên tài liệu này.' On the left, there is a preview section titled 'Bản xem trước' containing a sample document with a title 'TITLE' and some placeholder text. On the right, there is a 'Chọn máy in' (Select printer) section with the following settings:

Số bản	Bộ cục:	1
2	Dọc	
Số trang:	Kiểu in	
1 - 3	In một mặt	
Cỡ giấy:	Số trang mỗi tờ	Tỉ lệ
A4	2	100%

[Quay lại](#)

At the bottom, there are footer links: 'Bản quyền © 2023 Galacticos', 'Hỗ trợ', 'Điều khoản sử dụng', 'Chính sách bảo mật', 'Liên hệ', and a 'Vietnam' flag icon.

The user can view file content, settings and click to return to Orders page to review other files.

Screenshot of the 'Máy in' (Printer) page:

The page title is 'Máy in'. Below it is a sub-header: 'Danh sách các máy in trong hệ thống'. There are six images of an HP printer arranged in two rows of three. At the bottom, there are footer links: 'Bản quyền © 2023 Galacticos', 'Hỗ trợ', 'Điều khoản sử dụng', 'Chính sách bảo mật', 'Liên hệ', and a 'Vietnam' flag icon.

Printer view for students and admins can have information about printers' location, ID, status

### 3 Task 3: Architecture Design

#### 3.1 MVC Architecture, Presentation strategies, Data storing approach and API management

##### 3.1.1 Reasoning

###### Advantages

Due to each feature having multiple views and requiring various data operations:

For the order management and menu feature, users perform CRUD operations, necessitating multiple views for corresponding actions such as viewing, editing, and updating. Each operation also involves interactions with corresponding data, emphasizing the separation of concerns between view, controller, and model to maintain clear code implementation.

Employing a clear separation between the model, view, and controller facilitates easy code extension, particularly when dealing with the order management and menu features.

Separation of the model, view, and controller allows for the seamless addition of requirements related to data interaction independently of the user interface, making it easier to incorporate new features without affecting the existing display logic.

###### Disdvantages

Implementing complex code requires ensuring effective interactions between the model, view, and controller.

##### 3.1.2 MVC Architecture

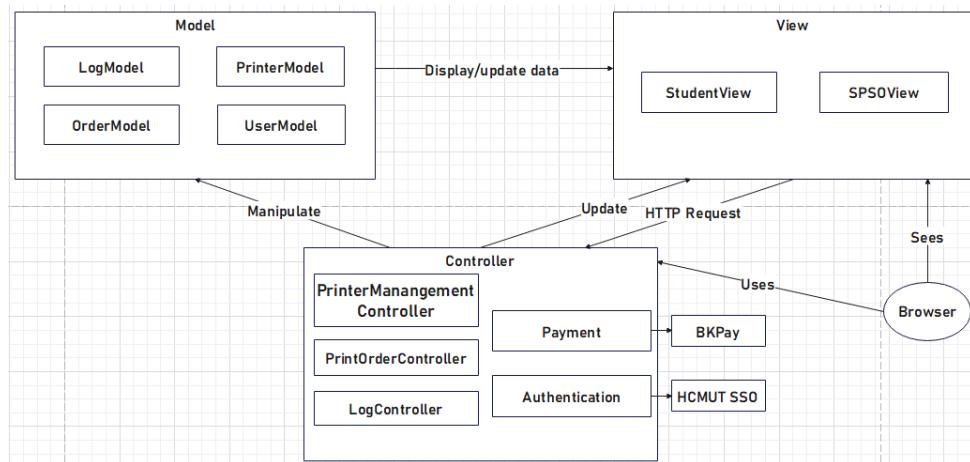


Figure 2: MVC Architecture for our SPSS system

###### 3.1.2.a Model

PrinterModel to store PrinterObject where we keep printer, UserModel to implement the user data, LogModel to create LogObject for keeping all records of the system, OrderModel for creating Order model

###### 3.1.2.b View

StudentView and SPSOView are given different screens since there's a difference in authority. Each view would have respective viewObj for each webpage.



### 3.1.2.c Controller

PrinterManagementController is used to do getter and setter on the printer database, the PrintOrderController is used to create Order, the LogController is used to create report. Moreover, Payment and Authentication is using foreign API from BKPay and HCMUT\_SSO due to security purpose.

### Flow of MVC architecture

Model module will keep display or update data for View module to keep the website up-to-date. View and Controller module have bidirectional interaction in which Controller will update data for View and View will request Controller for query database. Finally, a controller will manipulate data for model whenever the system needs.

### 3.1.3 Presentation strategies

#### 3.1.3.a User Interface Overview

In the presentation layer of the layered architecture, the goal is to create a user-centric and inclusive interface. The user interface (UI) is designed with a strong emphasis on user-friendliness, boasting a consistent layout that seamlessly adapts to various devices, with a desktop-first responsive design, and a color scheme harmonizing with HCMUT's theme, ensuring both sufficient contrast and size for readability. The user interface consists of two main components: one for students and another for the SPSO.

#### 3.1.3.b Layout

The contents is thoughtfully organized, featuring a sidebar for easy navigation, and main features are presented in the middle of the view port. Tabular data is presented coherently in lists or tables with uniform columns and rows. Crucially, important actions buttons/activators are strategically placed at the top and bottom of the screen to emphasize their functionality.

#### 3.1.3.c Language

The interface is delivered in both Vietnamese and English, catering to the majority of HCMUT students.

#### 3.1.3.d User Experience

User interactions are designed for ease of use, allowing navigation through the sidebar, one-click execution of common tasks, and user-friendly search and filtering options located conveniently at the top of the screen. Furthermore, the design takes into account the standard input devices (mouse and keyboard on PC and touch, swipe and other hand gestures on mobile or tablet devices), and provide adequate support for such input methods, e.g. mapping frequently used actions with shortcuts, e.g. 'Esc' key for Cancel/Dismiss action, 'Enter' key for submitting forms, etc., which greatly enhancing user efficiency.

Besides, understanding that the nature of user behaviour and the likelihood of unintended actions (misclicks, disrupted connections, etc.), the user interface provide an additional error-proof method right on the presentation layer, which prompts for reaffirmations of important or irreversible actions or saves the current state of the view during network downtime.



### 3.1.3.e Disability / Accessibility

The service stresses on providing the same quality of usage to the widest range of user possible. The screen reader functionality is integrated to verbalize visible contents such as images, videos to provide vocal support for individuals with vision impairments or reading difficulties.

### 3.1.4 Data storing approach

### 3.1.5 API Management

During production, the system should have its API service to ensure that our system is secured. The requests endpoint our services are hidden behind a proxy layer implemented in the API gateway, and every request is required a token for authentication.

- **BK Pay:** Our system does not access any information (system just sends a request of money that student need to pay for their use of service), and the payment information should be proceeded by BKPay department, also the system simply requires a navigation capability from BKPay service.
- **HCMUT SSO:** the endpoint is used together with SSPS application ID, which is registered through HCMUT central authentication department, alongside with the callback url to HCMUT SSO website. The application ID, also known as the client in the client - server of CAS authentication service, acts like an API key to access the feature of HCMUT SSO service.

### 3.1.6 Deployment Diagram

The system will store its user interface components (also known as the Frontend part) on a separate server. Since our frontend framework is chosen to be ReactJS, the bundled files (consists of App.vue , index.js and style.css) which are created in the build process will be sent to the client on request to the server (on loading page). The frontend server is built with Docker.

On the other hand, the frontend will communicate with the other components (services, database, etc.) via an API gateway. By implementing this, the system will gain the following benefits:

- Security: The API gateway acts as a proxy to prevent external sources from having access to the actual endpoints of our system, which prevent the APIs from (D)DOS attacks, or exposing sensible contents from the APIs.
- Rate-limiting and Caching: The SSPS service is estimated to handle a large quantity of requests at a time, it is valuable to have the capability to persist information from requests for an extended time period. Rate-limiting also helps in (D)DOS protection.

Implementing an API gateway in the system poses a significant implementation challenge, demanding thorough consideration and strategic planning in tandem with system design to fully harness its capabilities. When the frontend initiates a request to the backend or an external service, the request is directed to the API gateway and then routed to the designated endpoint. Presently, the system comprises three external services: HCMUT SSO for authentication, BKPay as the payment service, and our printing service managing incoming printing requests. Additionally, a backend processes requests related to authorization and data manipulation. User information for authorization and system-related data is stored in a MongoDB database directly connected to the backend. The backend incorporates business logic that aligns user information from the authentication service to assign the appropriate role (either student or SPSO). It further translates requests from the frontend into appropriate database usage using

MongoDB. Both the frontend and backend operate within a NodeJS environment, and the predominant request protocol is HTTP, with exceptions for queries between the backend server and the database.

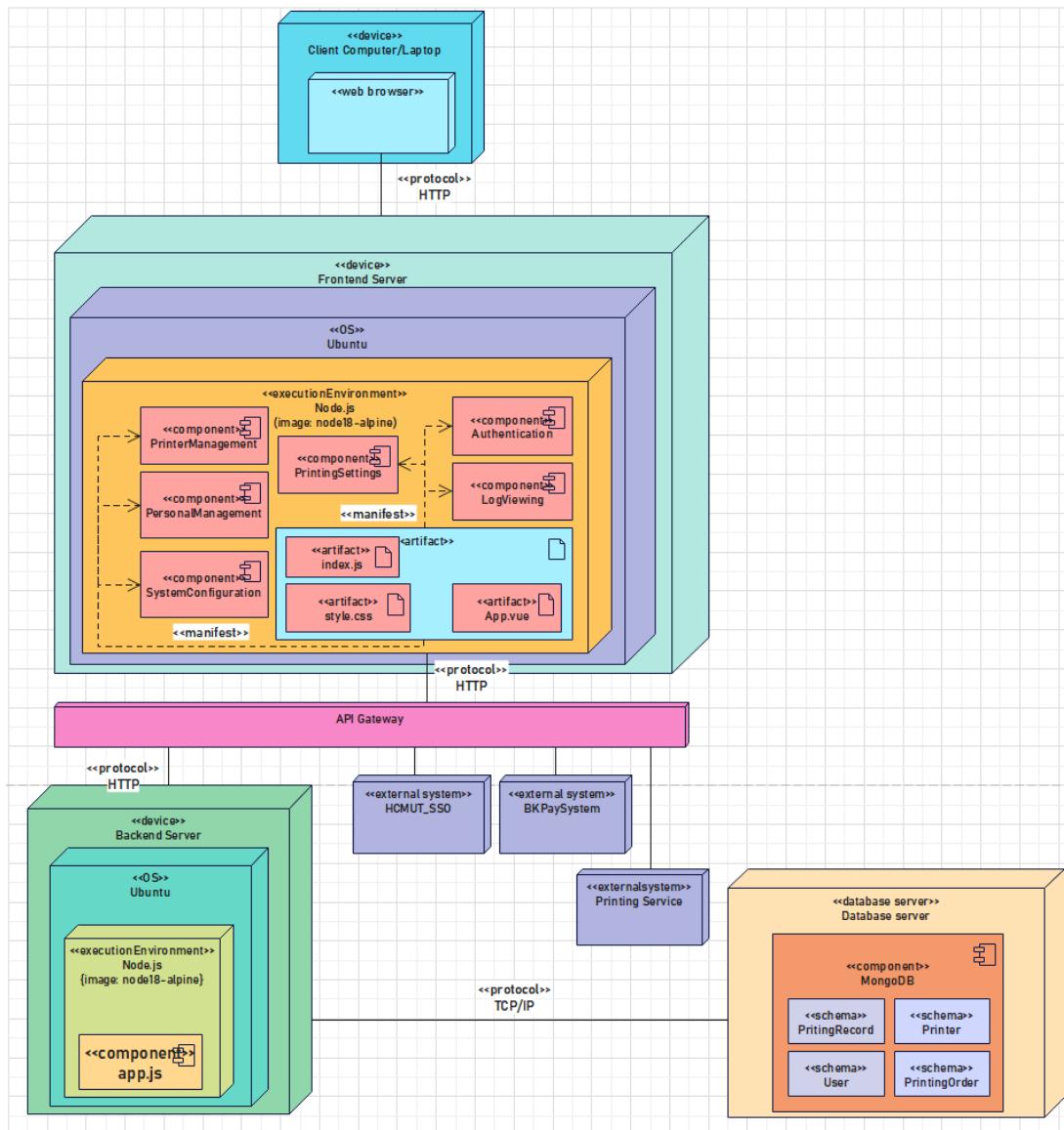
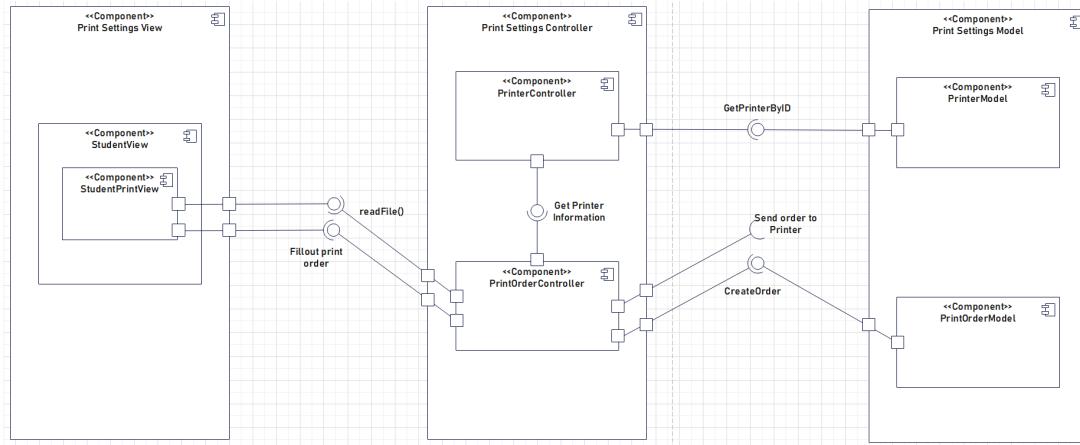


Figure 3: Deployment diagram

## 3.2 Component Diagram

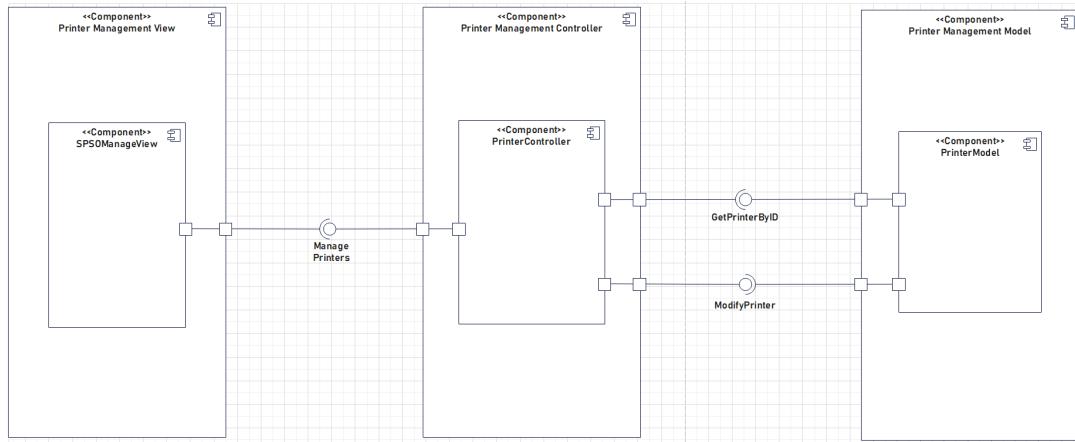
### 3.2.1 Printing Settings Module



**Figure 4:** Printing Settings Component Diagram

In this diagram, we can see that the PrintingOrderController will provide an interface for the StudentPrintView to fill in the order, while also getting the data from the user's upload. At the same time, the PrintingOrderController can get data from the Printer model to get the appropriate printer via lookup through the PrinterManagementController. After getting the order, the PrintingOrderController create the OrderObj based on the model and collect data, and then send this order to the printer to start printing.

### 3.2.2 Printer Management Module



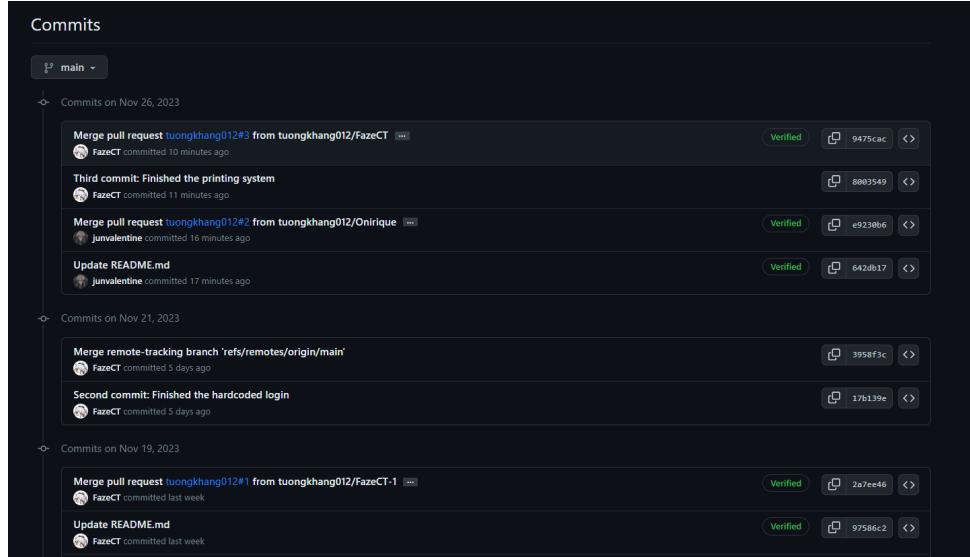
**Figure 5:** Printer Management Component Diagram

In this diagram, we can see that the PrinterController will provide an interface for the SPSOManageView to do their CRUD queries, some will require extra (Create, Update) data while some doesn't (Enable/Disable, Delete, View). On the other hand, the PrinterController will retrieve the corresponding printer to the SPSOManageView using the provided ID, and then proceed to modify on this printer based on the SPSO action via the SPSOManageView.

## 4 Implementation - Sprint 1

### 4.1 Online Repository Setup

We have already pushed our code onto Github. Our code, document, materials, folder are available at: <https://github.com/tuongkhang012/SPSSCNPM>



**Figure 6:** Commit history

### 4.2 Documents, Changelogs Setup

For documents, we started off with a simple README.md file, capturing the features and contributors of the project. In the future, it will be updated periodically, after each update (sprint). On the other hand, a changelog can be either a commit history, or a pull request from our online repository service.

### 4.3 Usability test

Usability testing means evaluating the usability of a design for a representative set of people. Users' experiences are observed by testers while they attempt to complete certain activities. From the beginning stages of development to product release, the testing process is often iterative. Software engineers can use testing to identify design faults that were previously unnoticed. Observing user interactions while attempting to complete a task also provides useful insights regarding how users use the software's capabilities. The team will conduct software feature testing in five steps in the future: recruiting test users, identifying tasks that test users must accomplish, determining the testing strategy, running the test, and collecting user feedback.

#### 4.3.1 Participant recruitment

For usability test on our system, we randomly choose 4 people to comment their experience about UI is developed by our team. Each person will test our UI twice. According to Nielsen Norman Group user experience research, our group choose 4 people in order to cover 75% of software flaws in the first round of testing. Moreover, if we choose less than 4 people, this will may result in failure to uncover all software usage concerns, or a user may mistakenly fulfill a task given by the team, causing problems for other



users. Due to time limit, our team cannot choose more than 4 people which is the limitation of usability testing phase.

Our team need create description and specific task for every participant. Task list need to be accurately and thoroughly documented according to the tester's objectives or software use cases that we have mentioned before, also each task needs to have a impact to software's quality, meaning that the task that we create not becoming useless. Here are some criteria for our task description :

- Avoid words or phrases that appear in the display or use-case descriptions.
- Build tasks which are highly practical and not too simple.
- Construct scenarios need to cover all case: giving a brief description about the context will help the users to understand the work that they need to accomplish. However, not all tasks need a hypothetical scenario, since it will make the task much more complicated with users.
- Do not describe the work as an instruction, which means describing it without containing steps to accomplish that task. Make the instruction secretly may help you find unseen scenario.

#### 4.3.2 Test strategy

From above task description, our team decide to evaluate usability test remotely. We have some reason for this :

- Easy to choose and make appointment for each participant. Some of them are really busy that we can only cooperate with them at night, moreover they really far away. This method can help we choose participant easier despite of distance, time
- Convenience, time-flexibility and economical for participant. This is make comfortable with participant and tester that not spend cost on travel, time,... make them more focus on evaluate. As remote test, it also results in more flexibility for the choice of time for both tester and participants.

Our team decided to use qualitative methods instead of quantitative. This is because our team focus shifts more towards user's behaviors as well as their experience while interacting with the application. Moreover, limitations on tools and time for measurements and analysis leads us to believe that qualitative methods are the better option for our case.

### 4.4 Conduct the test

We conduct our usability test as following table:

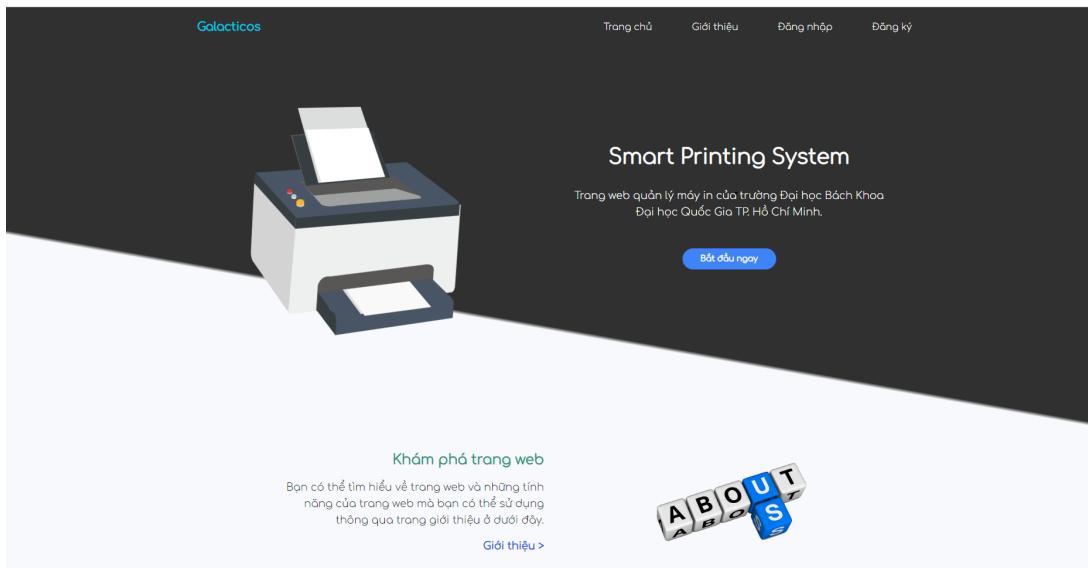


Figure 7: Homepage before login

The screenshot shows the homepage of the "Smart Printing System" after logging in. The top navigation bar remains the same. The main content area is divided into several sections: 1) A news feed item from "AkaneLink" with a timestamp of "15 giờ trước" and a link to "Đánh giá trang web: 10/10!". It includes a short description of the website's features. 2) A news feed item from "SPSO" with a timestamp of "7 ngày trước" and a link to "Giới thiệu về smart printing system". It also includes a short description. 3) A sidebar with four cards: "In tài liệu?", "Mua thêm giấy?", "Xem đơn in?", and "Bạn muốn đóng góp?". Each card contains a brief description and a corresponding button ("In tài liệu", "Mua giấy", "Đơn in", "Đóng góp"). At the bottom right, there is a "Cần thông tin?" section with a link to "Liên hệ SPSO nhanh".

Figure 8: Homepage after login

## Giới thiệu

Những tiện ích của trang web

### Trang web in ấn online

Ứng dụng web này rất tiện lợi khi bạn cần in một tệp tài liệu. Nó không yêu cầu cài đặt và hoạt động trực tiếp trên trình duyệt của bạn.

### Tính bảo mật cao

Các tệp của bạn sẽ được xóa khỏi máy chủ của ứng dụng vài giờ sau khi thực hiện việc in ấn. Không ai có quyền truy cập vào chúng trừ bạn.

### Dễ dàng sử dụng

Ứng dụng sử dụng giao diện thân thiện với người dùng, với hướng dẫn để đọc và được tích hợp các thao tác rất đơn giản.

### Đa dạng về cài đặt

Trang web này cho phép bạn thay đổi các cài đặt trước khi in, với nhiều cấu hình khác nhau như bộ cục, kích thước giấy hoặc thậm chí là tỷ lệ trang in.

### Đa dạng về loại tệp tin

Ứng dụng hỗ trợ hầu hết các định dạng tệp được sử dụng nhiều (doc, docx, pdf). Nếu tệp của bạn không mở được, thì có thể tệp tin bị hỏng hoặc quá lớn.

### Truy cập mọi nơi

Chỉ cần bạn thiết lập quốc gia của mình, chúng tôi sẽ hiển thị những gì ứng dụng có thể cung cấp cho địa điểm cụ thể đó.

**Figure 9:** Introduction of website after click "Giới thiệu"

## Máy in

Danh sách các máy in trong hệ thống



**Figure 10:** List of printer

Galacticos Trang chủ Giới thiệu Máy in In tài liệu Đơn in Đóng góp

## In tài liệu

Lựa chọn tài liệu mà bạn muốn in

Nhập để tải file lên hoặc kéo thả  
.doc, .docx hoặc .pdf

**Trang web in ấn online**

Ứng dụng web này rất tiện lợi khi bạn cần in một tệp tài liệu. Nó không yêu cầu cài đặt và hoạt động trực tiếp trên trình duyệt của bạn.

**Tính bảo mật cao**

Các tệp của bạn sẽ được xóa khỏi máy chủ của ứng dụng vài giờ sau khi thực hiện việc in ấn. Không ai có quyền truy cập vào chúng trừ bạn.

**Dễ dàng sử dụng**

Ứng dụng sử dụng giao diện thân thiện với người dùng, với hướng dẫn dễ đọc và được tích hợp các thao tác rất đơn giản.

**Đa dạng về cài đặt**

Trong web này cho phép bạn thay đổi các cài đặt trước khi in, với nhiều cấu hình khác nhau như bối cảnh, kích thước giấy hoặc thậm chí là tỷ lệ trong in.

**Đa dạng về loại tệp tin**

Ứng dụng hỗ trợ hầu hết các định dạng tệp để sử dụng (.doc, .docx, .pdf). Nếu tệp của bạn không mở được, thì có thể tệp tin bị hỏng hoặc quá lớn.

**Truy cập mọi nơi**

Chỉ cần bạn thiết lập quốc gia của mình, chúng tôi sẽ hiển thị những gì ứng dụng có thể cung cấp cho địa điểm cụ thể đó.

**Figure 11:** Upload place after click In tài liệu on navigation bar

Galacticos Trang chủ Giới thiệu Máy in In tài liệu Đơn in Đóng góp

## In tài liệu

Lựa chọn tài liệu mà bạn muốn in

Nhập để tải file lên hoặc kéo thả  
.doc, .docx hoặc .pdf

**Trang web in ấn online**

Ứng dụng web này rất tiện lợi khi bạn cần in một tệp tài liệu. Nó không yêu cầu cài đặt và hoạt động trực tiếp trên trình duyệt của bạn.

**Tính bảo mật cao**

Các tệp của bạn sẽ được xóa khỏi máy chủ của ứng dụng vài giờ sau khi thực hiện việc in ấn. Không ai có quyền truy cập vào chúng trừ bạn.

**Dễ dàng sử dụng**

Ứng dụng sử dụng giao diện thân thiện với người dùng, với hướng dẫn dễ đọc và được tích hợp các thao tác rất đơn giản.

**Đa dạng về cài đặt**

Trong web này cho phép bạn thay đổi các cài đặt trước khi in, với nhiều cấu hình khác nhau như bối cảnh, kích thước giấy hoặc thậm chí là tỷ lệ trong in.

**Đa dạng về loại tệp tin**

Ứng dụng hỗ trợ hầu hết các định dạng tệp để sử dụng (.doc, .docx, .pdf). Nếu tệp của bạn không mở được, thì có thể tệp tin bị hỏng hoặc quá lớn.

**Truy cập mọi nơi**

Chỉ cần bạn thiết lập quốc gia của mình, chúng tôi sẽ hiển thị những gì ứng dụng có thể cung cấp cho địa điểm cụ thể đó.

Thiết kế giao diện  
tối ưu hóa  
để đọc  
rất đơn  
giản

Ứng dụng  
sử dụng  
giao diện  
thân thiện  
với người  
dùng, với  
hướng dẫn  
dễ đọc  
và được  
tích hợp  
các thao  
tác rất  
đơn  
giản.

Chỉ cần  
bạn thiết  
lập quốc  
gia của  
mình,  
chúng tôi  
sẽ hiển  
thì những  
giá  
ứng dụng  
có thể  
cung cấp  
cho địa  
điểm  
cụ thể  
đó.

**Figure 12:** File choosing



Galacticos Trang chủ Giới thiệu Máy in In tài liệu Đơn in Đóng góp

## In tài liệu

Chỉnh sửa thông số cho bản in

Bản xem trước

Chọn máy in

Máy in

Số bản in Bố cục

1 Portrait

Trang cần in Kiểu in

Tổng bộ In 1 mặt

Khổ giấy Trang/mặt Tỉ lệ

A4 1 100%

Bạn hiện còn 8 tờ giấy để in.

In tài liệu

Figure 13: Adjust printing option

III CƠ SỞ DỮ LIỆU

Chỉnh sửa thông số cho bản in

Bản xem trước

Chọn máy in

Máy in

Cơ sở 1 > CS1 - 111112  
Cơ sở 2 > CS1 - 111113  
CS1 - 111114  
CS1 - 111115  
CS1 - 111116  
CS1 - 111117

Trang cần in

Tổng bộ

Khổ giấy Trang/mặt Tỉ lệ

A4 1 100%

Bạn hiện còn 8 tờ giấy để in.

In tài liệu

Figure 14: Choose printer in Ly Thuong Kiet branch



## III Tạo In

Chỉnh sửa thông số cho bản in

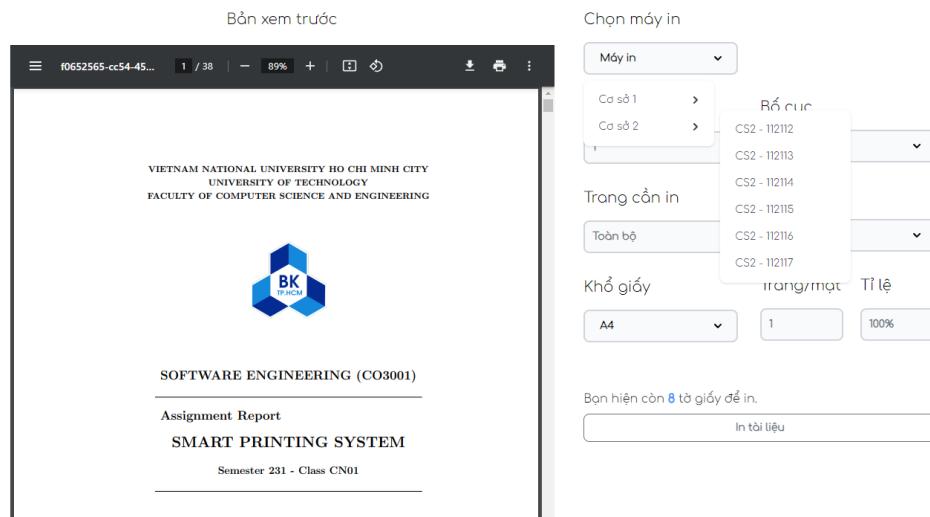


Figure 15: Choose printer in Thu Duc branch



## References

- [1] Smart printing service for students at HCMUT - <https://link.gdsc.app/DFUvUxb>