HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY
School of Information and Communication Technology

FINAL PROJECT REPORT

Group 1

IT3100E – Object Oriented Programming

Class: 139411

Lecturer: PhD. Trinh Tuan Dat

Semester 20221

Hanoi, June 2023

TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION

The course IT3100E – Object Oriented Programming provides students with object-oriented concepts, languages, principles, and techniques. Students are first introduced to object-oriented technology, the overview of Java programming language and Unified Modelling Language (UML). Four object-oriented programming principles, i.e., abstraction, encapsulation, inheritance, and polymorphism, are then delivered out also. Aggregation, association, abstract class, interface as well as generic programming, exception handling, and graphical user interface (GUI) programming with Java, during the course, are presented to students.

This hands-on project is assigned to groups of students along with the course to apply the knowledge related to the design of object-oriented programs to an object-oriented application solving real-world problems.

In this report, our group, under the guidance of Prof. Trinh Tuan Dat, will present the ways in which our group deal with the project assignment in details, which includes system design, application design, algorithms, GUI, technologies, etc. every component of our programme besides team contributions and project process management.

Our team members include:

Student's name	Student's ID
Nguyen Trong Huy	20210451
Bui Phuong Nam	20215227
Tran Duc Nam	20215228
Trinh Giang Nam	20215229
Nguyen Chinh Minh	20215224
Hoang Minh Quan	20215236

Figure 1 Group 1's members

CHAPTER 2. PROBLEM DESCRIPTION

I. Study Case

There are numerous websites that provide information about the history of Vietnam, such *as https://nguoikesu.com*, *Wikipedia*, *DBPedia*, and more. The task is to search and automatically gather data about the history of Vietnam from these websites and interlink the collected data. The entities to be collected include:

- Historical dynasties of Vietnam
- Historical figures of Vietnam
- Tourist destinations and historical landmarks
- Cultural festivals
- Historical events in Vietnam

Each entity needs to have an identifier and various attributes. Importantly, the entities should be interconnected.

Please note that:

- Data gathering process must be solved automatically.
- Consistency in naming attributes for each entity.

However, there are many criteria to evaluate your system:

- A diverse range of entities for each type from multiple sources.
- Ensure accuracy.
- Data integration from multiple sources is required.

For the final version of your application, the collected data needs to be stored in either JSON or CSV format. Subsequently, provide search functionality and display information for end users.

II. Problem Solving Strategies

In our very first stage to handle this problem, developing a strategy to develop our system serves as the bridge to the success of the project.

To facilitate the software development process under such requirements, we have detailed plans for each stage of developing our product for the study case in a period of 6 weeks of project. The way we allocate individuals to different jobs will be shown later in the appendix of this report.

Stage	Description	Period
Requirement Analysis	- Analyse the requirement of the study case. - Feature the specific functionality that the system should have. - Examine the websites that are helpful for data crawling. - Study the process to crawl data from a website	3-4 days
Design	- System design - Program design	1 week
Implementation	- Coding - GUI implementation	3 weeks
Integration & Testing	- Integrate each component of system - Mannual Testing	4-5 days
Release	- Deliver final report, source code, etc. - Presentation & demo video	-

Figure 2 Details of our development process

III. Technologies, Frameworks, Libraries in use

This table describes tools that we use to build up our program.

Tools	Objectives
E(fx)clipse Windows 64 bits	IDE
GitHub	Version Control
Asana	Project Management
SceneBuilder	GUI design
Java	Programming Language
CSS	Styling language
Maven Project	Java library management tool
Astah	UML design tool

Figure 3 Technologies in use

Here are some Java libraries we use during the implementation process.

Library	Version	Description
JDK	19.0.0	Java core library
gson	2.9.0	Converting Java objects to JSON
json-simple	1.1.1	Parsing and generating JSON
jsoup	1.15.3	Web scraping and HTML parsing
json	20220320	A lightweight data interchange format
javaFX	16	GUI coding (event handling, …)

Figure 4 Java libraries

CHAPTER 3. REQUIREMENT ANALYSIS

I. Base data Specification

When attempting to do a survey related to the entities, we realise that these entities should have the following information for the final system.

Entity	Attribute	Description
Thời kỳ (Dynasties)	Tên (Name)	This entity depicts all dynasties of Viet Nam History
	Kinh đô (Capital)	
	Các đời vua (Kings)	
	Người sáng lập (Founder)	
	Thời gian tồn tại (Period)	
	Quốc hiệu (Nation's name)	
Nhân vật lịch sử (Figures)	Tên (Name)	This entity lists all Vietnamese historical figures, which may also include Vua (King)
	Năm sinh (Year of birth)	
	Năm mất (Year of death)	
	Quê quán (Hometown)	
	Thời kỳ (Dynasty)	
Sự kiện lịch sử (Events)	Tên (Name)	This concept shows information of Vietnamese historical events. This also includes Chiến Tranh (Vietnamese War)
	Thời gian (Period)	
	Thời kỳ (Dynasty)	
	Nhân vật liên quan (Figure)	
	Nội dung (Content)	
Lễ hội (Festivals)	Tên (Name)	Describe Vietnamese historical festivals
	Thời gian (Period)	
	Địa điểm (Place)	
	Nhân vật liên quan (Figure)	
Di tích (Relics)	Tên (Name)	List all Vietnamese relics
	Địa điểm (Place)	
	Loại di tích (Classification)	
	Năm (Year of recognition)	
	Nhân vật liên quan (Figure)	

Figure 5 Base data

II. Business process analysis

To get into the process of the system, we first need to estimate the business requirement. Based on that, we then can divide the business process into two main processes: data viewing process and web scraping process. The first term describes the way end users could search for data in the final program, from that we can concentrate on GUI design that meet the user experience. While the later one describes the way the system could get the data from the website automatically and then supply the data for the backend process.

For each process analysis, we need to make enquiries about what the clients want for the final version of the system besides how the data could be obtained from the website to deliver the activity diagrams, which can be considered the foundation to system design.

By doing this stage, we can easily approach the system design and progamming design regarding client-oriented requirements and minimal error.

1. Data searching process activity diagram

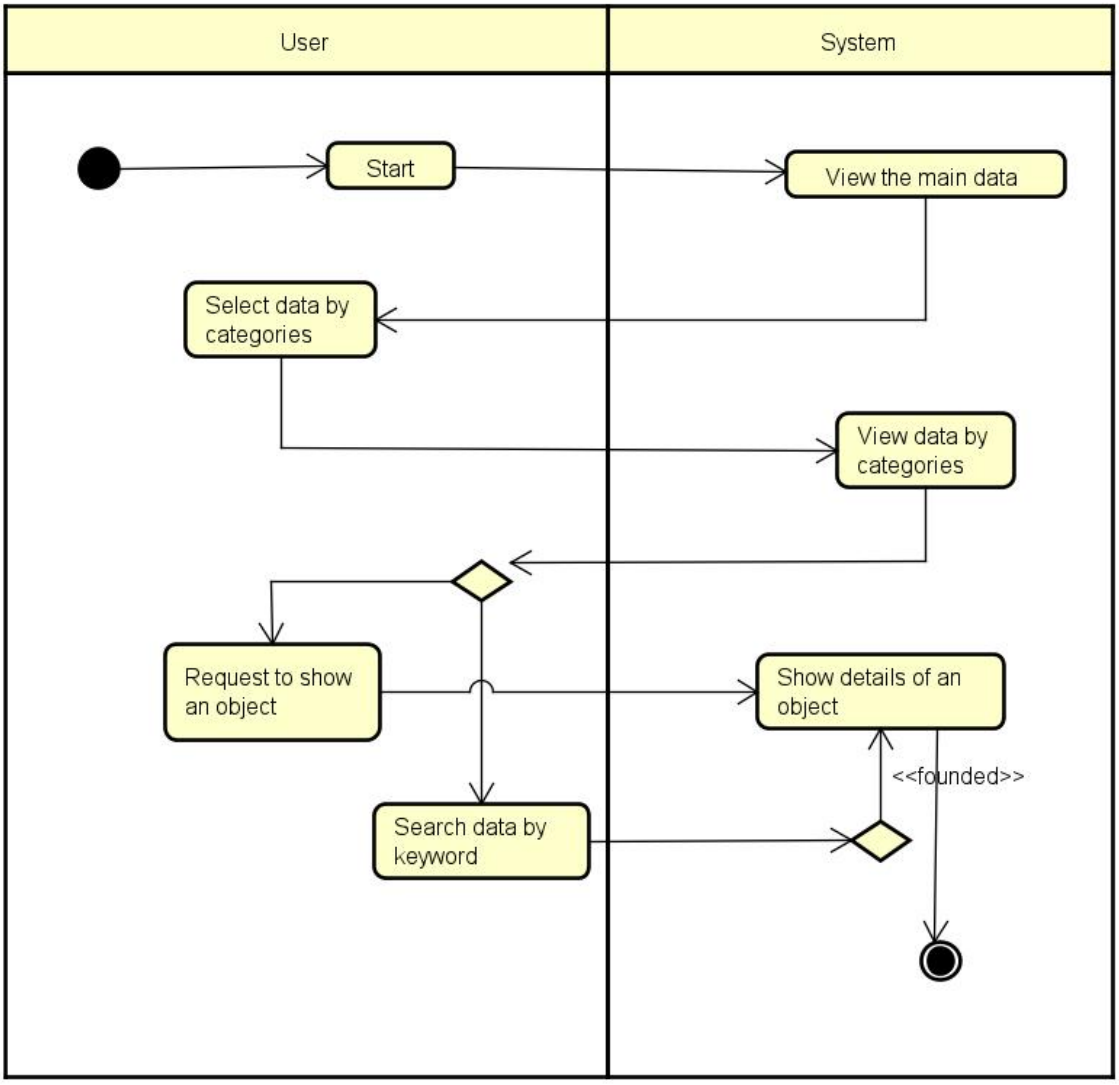


Figure 6 Data viewing process analysis

2. Web scraping process activity diagram

Based on what we discovered about the web scraping process, which shows below, we propose the web scraping process activity diagram.

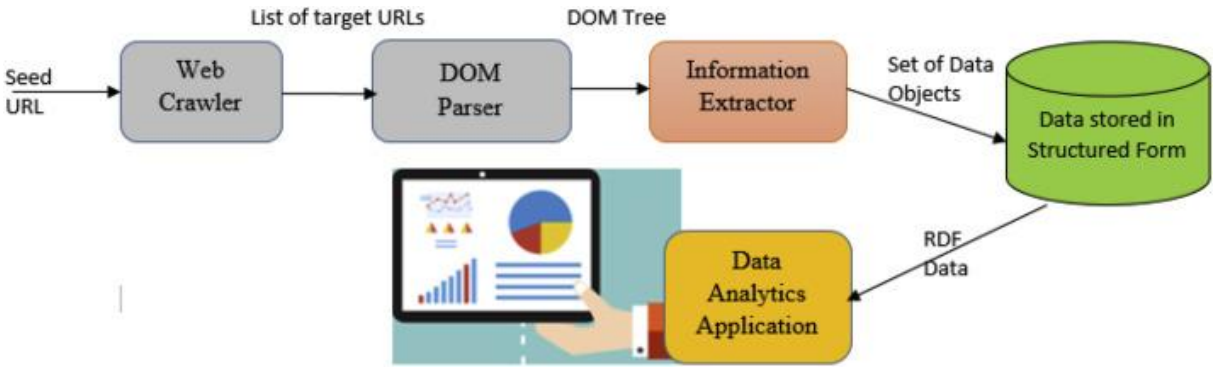


Figure 7 Actual web scraping process

This activity diagram might affect that way we develop class diagram for web scraping subsystem.

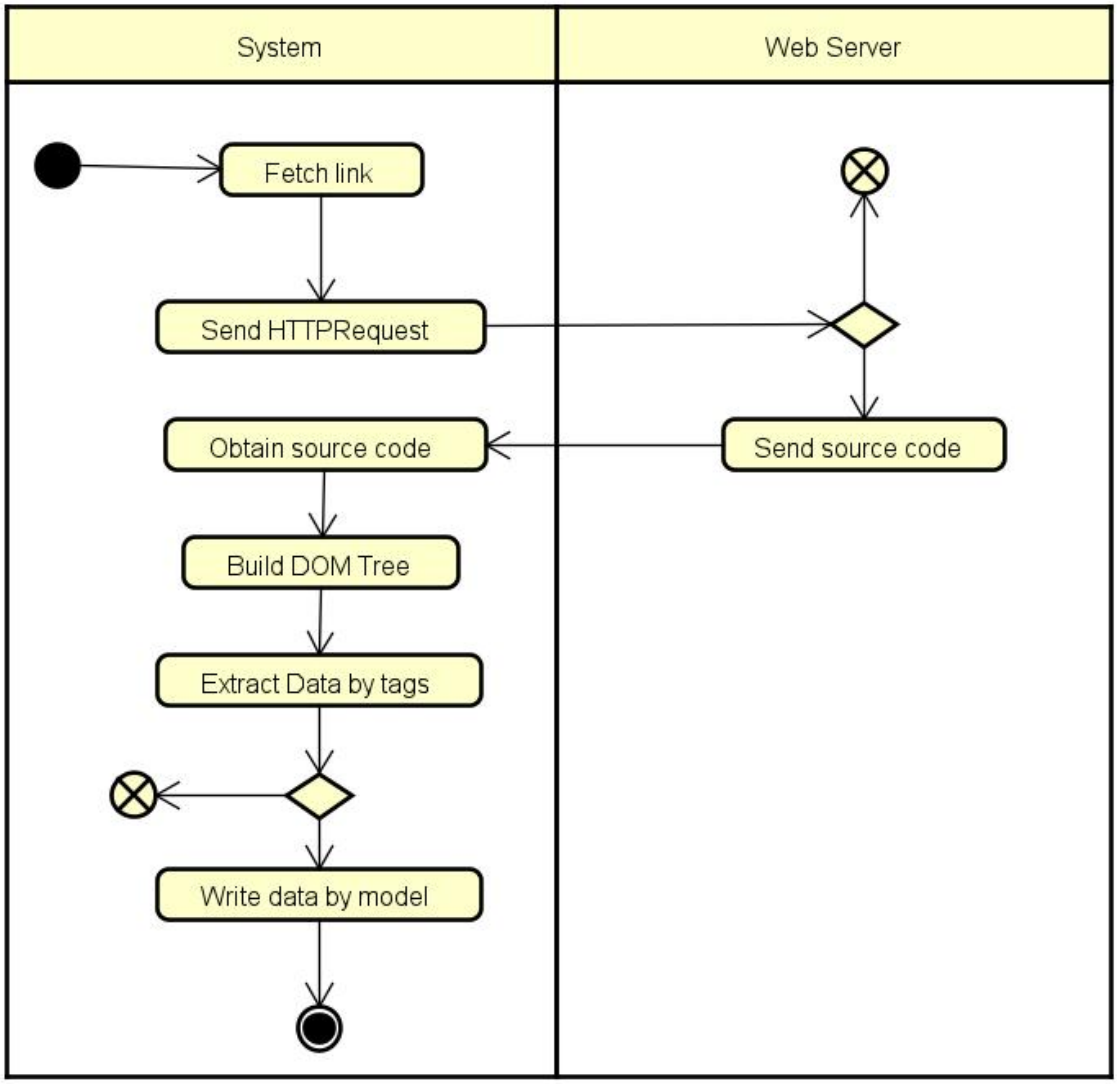


Figure 8 Web scraping process activity diagram

III. Use Case diagram

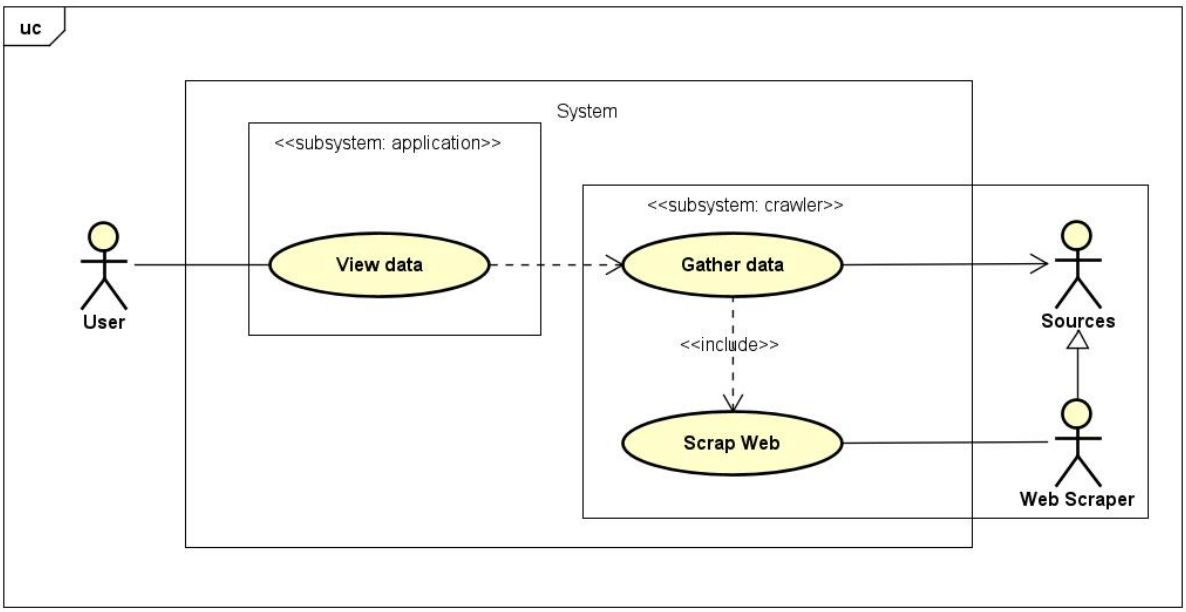


Figure 9 Use case diagram.

Use case “View data” details:

UC	View data
Primary actor	User
Secondary actor	No
Pre-condition	- The web data scraping process has been successfully completed. - The scraped data has been stored in a structured format.
Post-condition	- The User is able to view the scraped data.
Main flows	1. The data scraping process has been successfully completed. The scraped data has been stored in a structured format. 2. The application presents a list of available datasets or categories of scraped data to the users. 3. The user selects a specific data to view. 4. The user can navigate or search data in format.
Regular variants	- The user exits the program
Exceptional flows	No

Figure 10 Use case "view data" details

Use case “Gather data” details:

UC	Gather data
Primary actor	No
Secondary actor	Sources
Pre-condition	- The system requires to access the source to collect data
Post-condition	- Successful connection
Main flows	1. After connecting successfully to the data source, it gathers the source code. 2. Extract source code which includes data. 3. Store data in structured format.
Regular variants	- No
Exceptional flows	- Failed connection - Timeout request

Figure 11 Use case "gather data" details.

Use case “Scrap Web” details:

UC	Scrap Web
Primary actor	Web Scraper
Secondary actor	No
Pre-condition	- Web Scraper has access to the target websites. - The Web Scraper is configured with the necessary scraping rules or algorithms.
Post-condition	- Relevant data from the target websites has been scraped and extracted.
Main flows	1. The Web Scraper identifies the target websites. 2. The Web Scraper establishes a connection with the target websites. 3. For each web page, the web scraper applies the defined scraping rules or algorithms to extract the desired data. 4. The web scraper stored data in structured format.
Regular variants	- No
Exceptional flows	- The Web Scraper logs the error or notifies the system administrator. - The Web Scraper may attempt to retry the scraping process or skip the problematic web page. - The Web Scraper detects changes in the target websites' structure or conten

Figure 12 Use case "scrap web" details

CHAPTER 4. DESIGN ANALYSIS

I. System Design: Package diagram

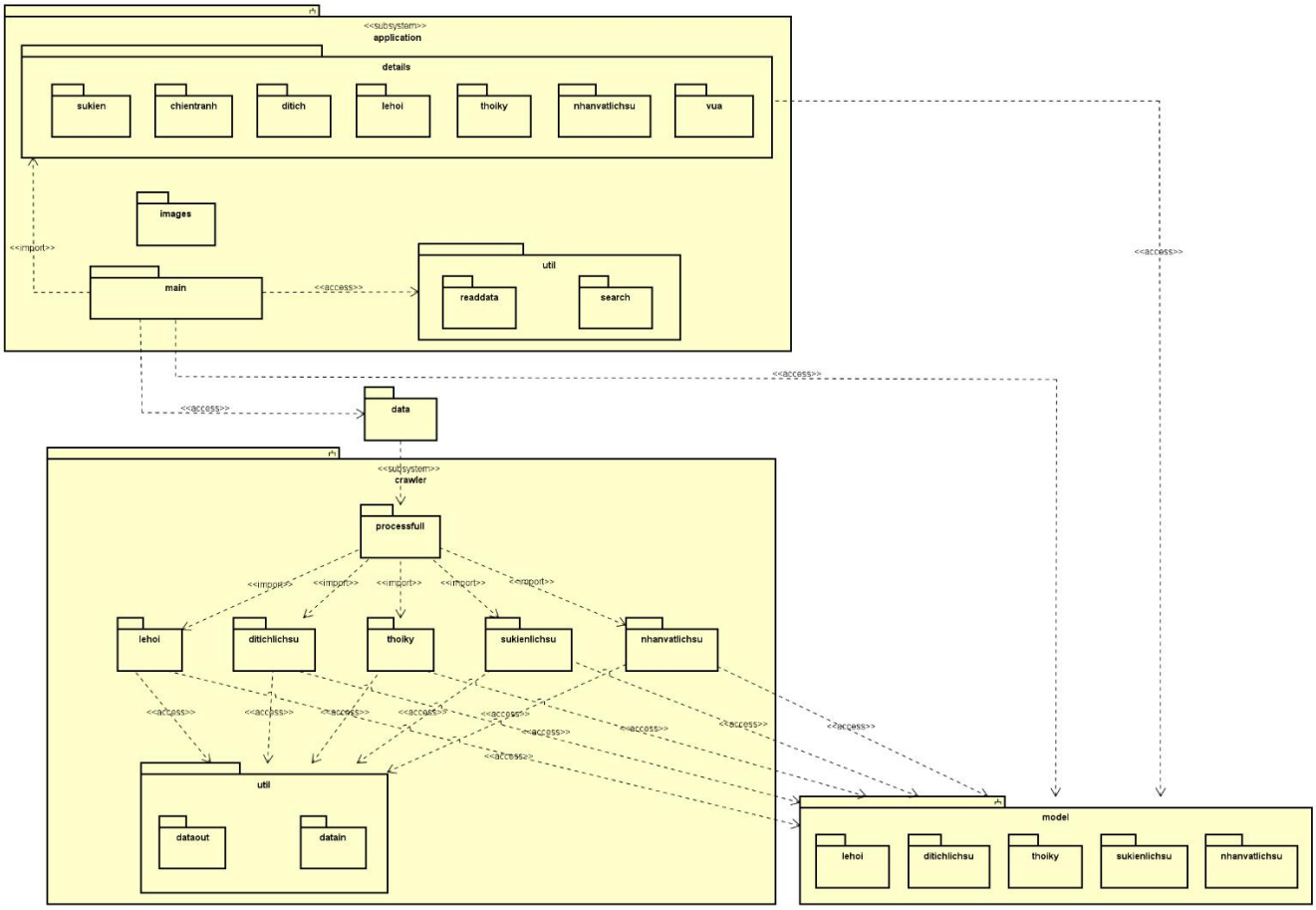


Figure 13 Package diagram of system design

The above figure shows the overall system design, which is described by package diagram.

Based on how data should flow in our system, we derive the system design.

In our system we divide into 2 subsystems: crawler, application, and the base model.

Package "*model*" defines how data should be stored in our system, and then when data is scraped from the website, it could be processed into the way how this model defines.

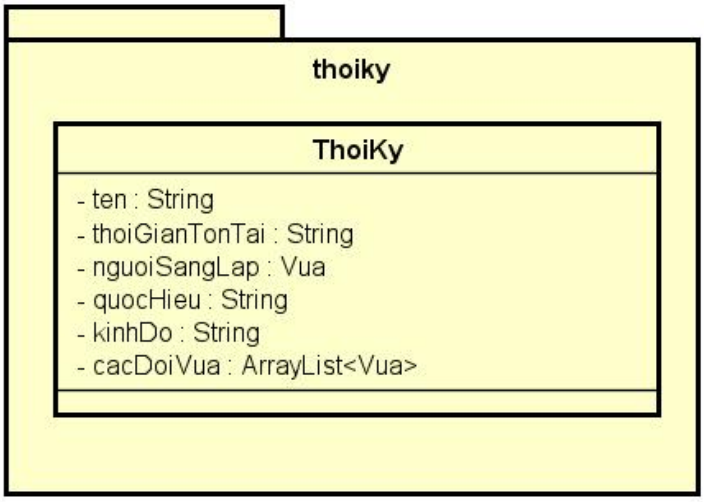
The subsystem "*crawler*" plays the role as a processing stage. It provides the stage and instruction to crawl data from the website based on the mould package "*model*" defines. In this sub system, there are many small packages: *lehoi*, *ditichlichsu*, *thoiky*, *sukienlichsu*, *nhanvatlichsu*, *processfull* and an *util* package. "*Util*" package owns the abstract classes, interfaces that the others should follow and crawl data. "*processfull*" package is the final stage where collects data from the others and stored it in Json file in the data package outside the subsystem.

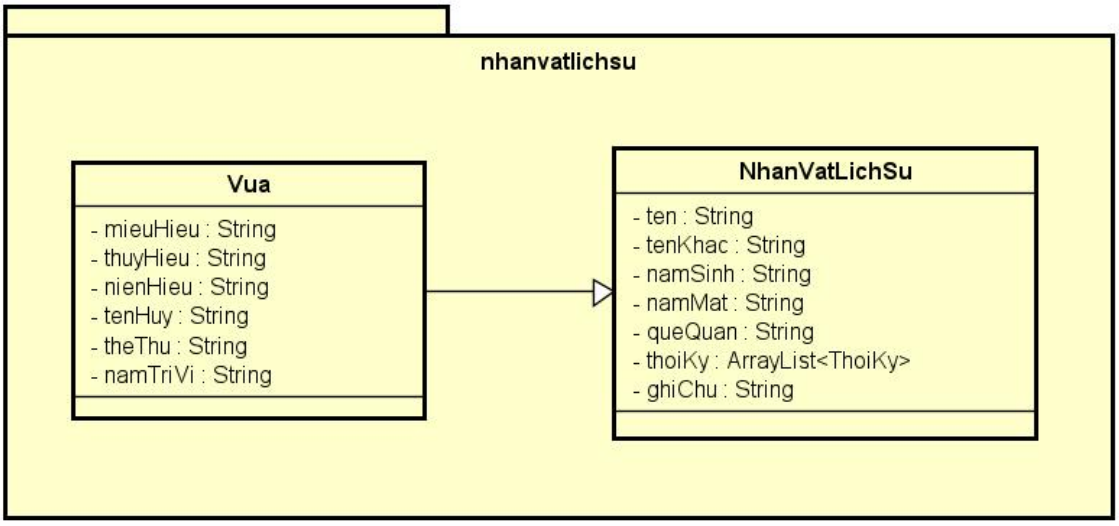
The subsystem "*application*" provides GUI for end user where collects data from data package which is supplied by subsystem "crawler" and follows the rules given by base package model. "*Util*" package gives the functionality that the application performs, and the end users can interact with the most outer layer of the system. The "*details*" package provides users with pop-ups when they want to view the details of an object. While "*images*" package provides media, "*main*" package provides the final application.

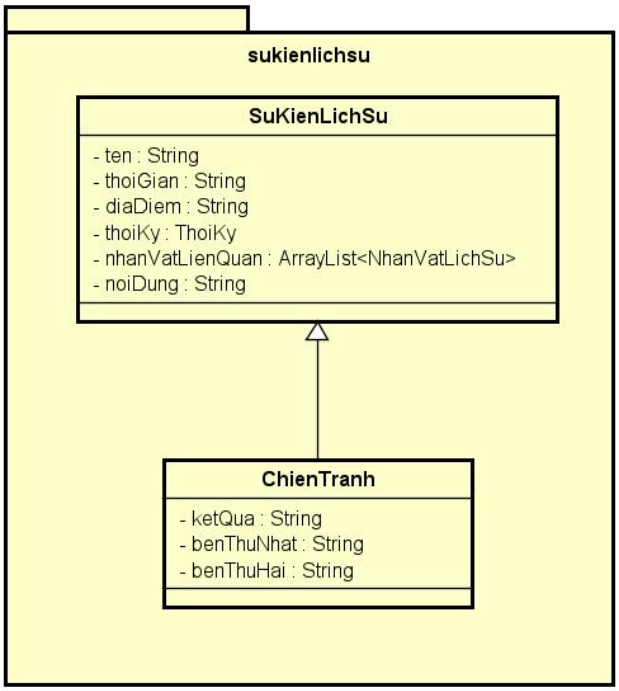
II. Program Design: Class diagram

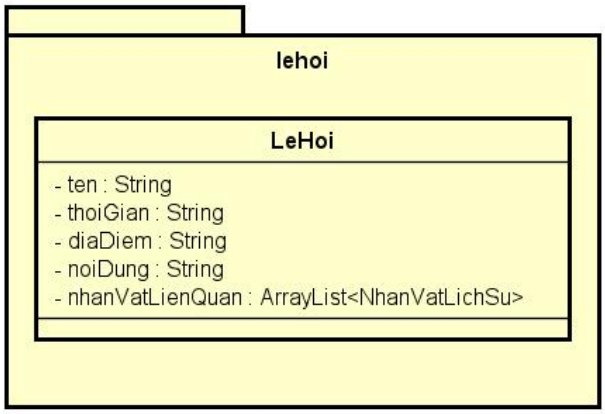
As we define above, the source code will be stored in that structure. For each package we come to the details by giving class diagram.

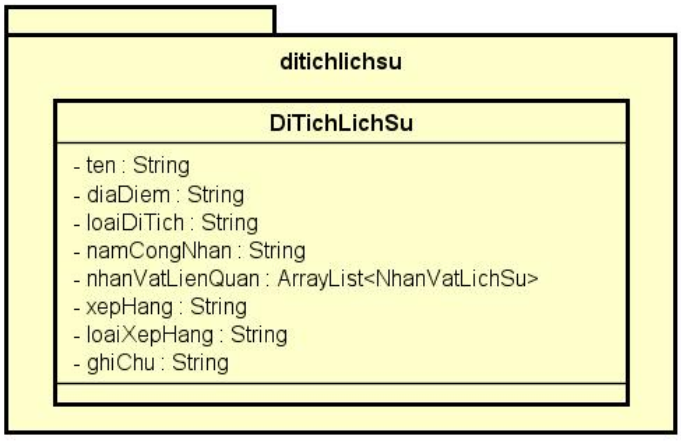
1. Package "model"






sukienlichsu
SuKienLichSu
- ten : String
- thoiGian : String
- diaDiem : String
- thoiKy : ThoiKy
- nhanVatLienQuan : ArrayList<NhanVatLichSu>
- noiDung : String
ChienTranh
- ketQua : String
- benThuNhat : String
- benThuHai : String


lehoi
LeHoi
- ten : String
- thoiGian : String
- diaDiem : String
- noiDung : String
- nhanVatLienQuan : ArrayList<NhanVatLichSu>


ditichlichsu
DiTichLichSu
- ten : String
- diaDiem : String
- loaiDiTich : String
- namCongNhan : String
- nhanVatLienQuan : ArrayList<NhanVatLichSu>
- xepHang : String
- loaiXepHang : String
- ghiChu : String

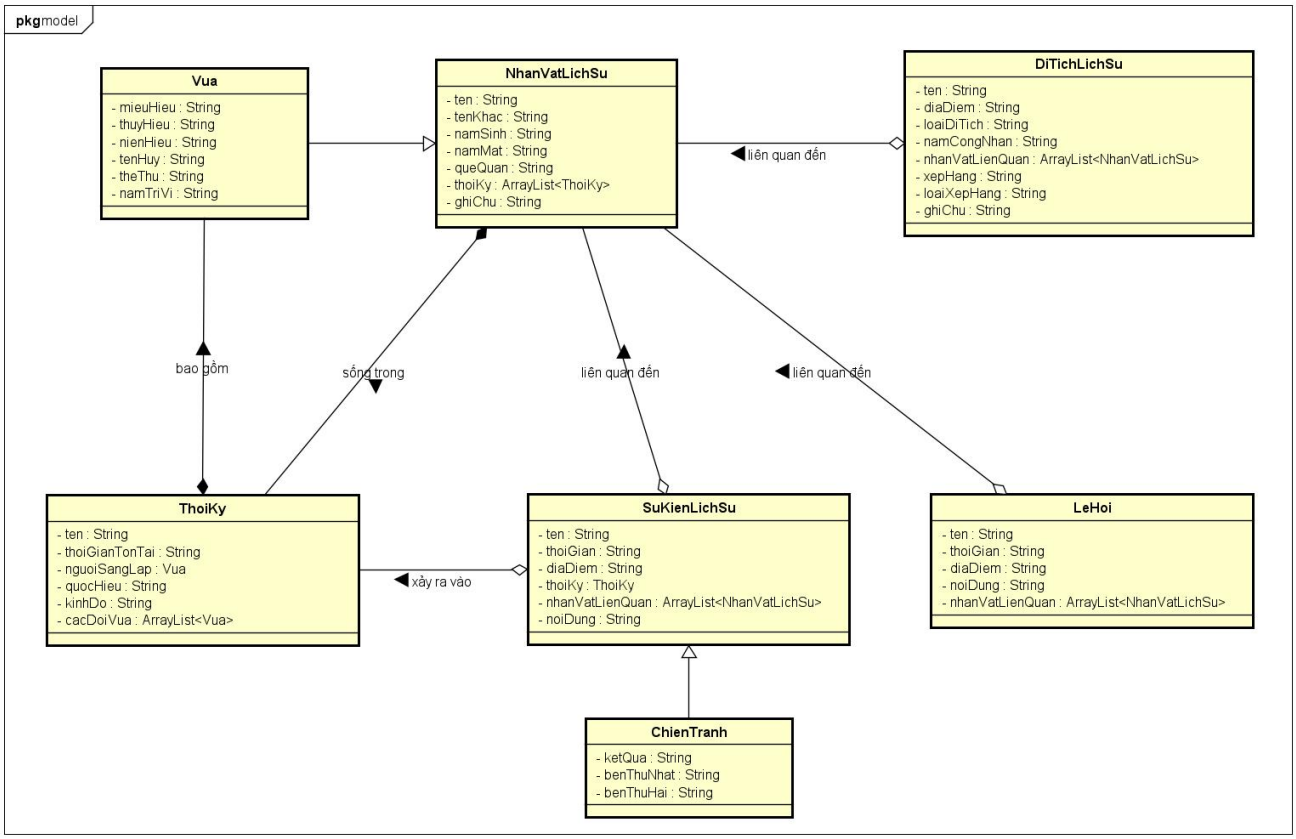


Figure 14 "model" class diagram

The following figure describes the class diagram in the package "*model*". This indicates all attributes and getter/setter methods that our system should follow and collect data from websites. There are 8 relationships between each pair of classes: 2 generalization relationships, 2 composition relationships, and 4 aggregation relationships.

The number of attributes for each entity and the relationship between all entities are described in detail in the figure. The attribute and relationship are decided based on the requirement analysis and the fact what we can collect from the real website, which improves the quality of the data collected.

2. Package “crawler”

2.1. Package crawler.util

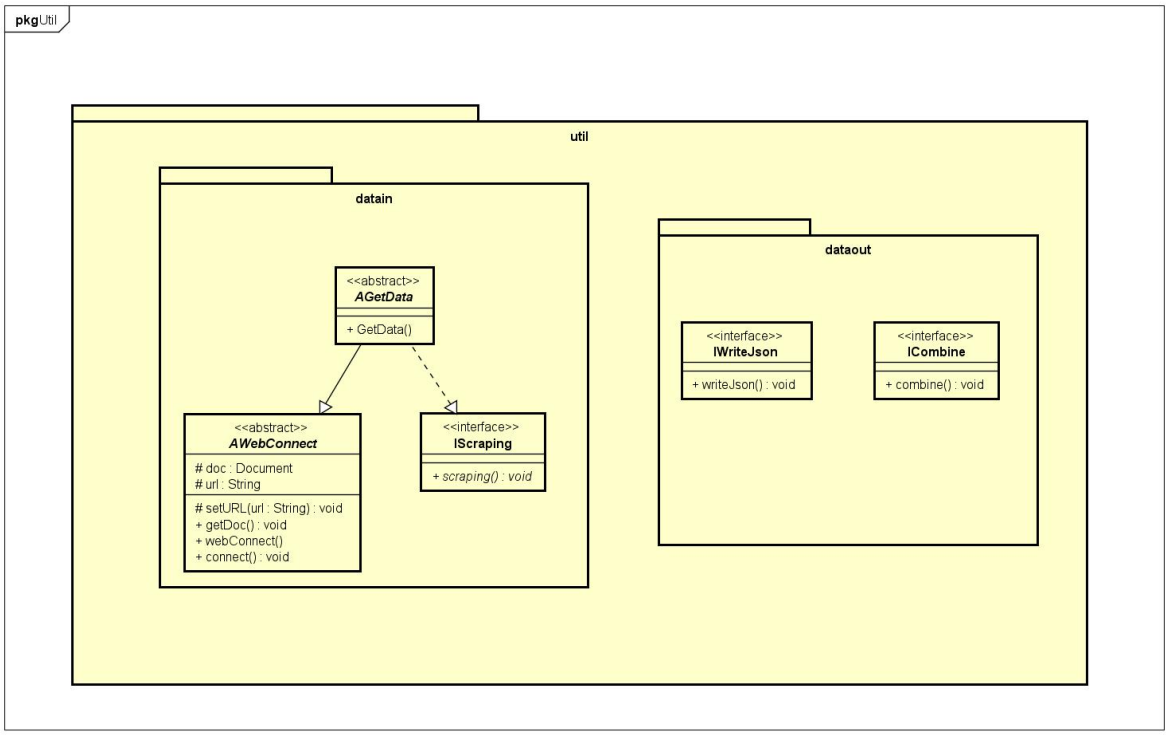


Figure 15 crawler.util package class diagram

In package crawler.util, which provides attributes and methods that the other classes. There are two smaller packages in this one: datain, and dataout.

Package crawler.util.datain helps to connect to web server and extract data. This was built based on the web scrap process. Firstly, we created an abstract class “AWebConnect”, which has two attributes: url (direct link to website to scrap) and doc (document contains the DOM element of web we need to crawl). Secondly, we created an interface “Iscraping”, which serves to scrap specific data from websites. Finally, an abstract class “AGetData” extends “AWebConnect” and implements Iscraping, form a general process to scrap data from a website.

Package crawler.util.dataout provides two interfaces: IWrtiteJson, which helps to convert data after scrap from web, then put in the model and write to Json file and ICombine provides combine method to gather data from multiple website, and filter them.

2.2. Package crawler.thoiky

In package crawler.thoiky, for each website, we create a class to scrap data from that website by interiting AGetData. After crawling data from all websites, “*ThoiKyFull*” class will combine all by implementing “*ICombine*” interface and export to Json file by implementing “*IWriteJson*” interface.

The package crawler.thoiky has a general class diagram as shown below. And the details of which class performs website is also shown below.

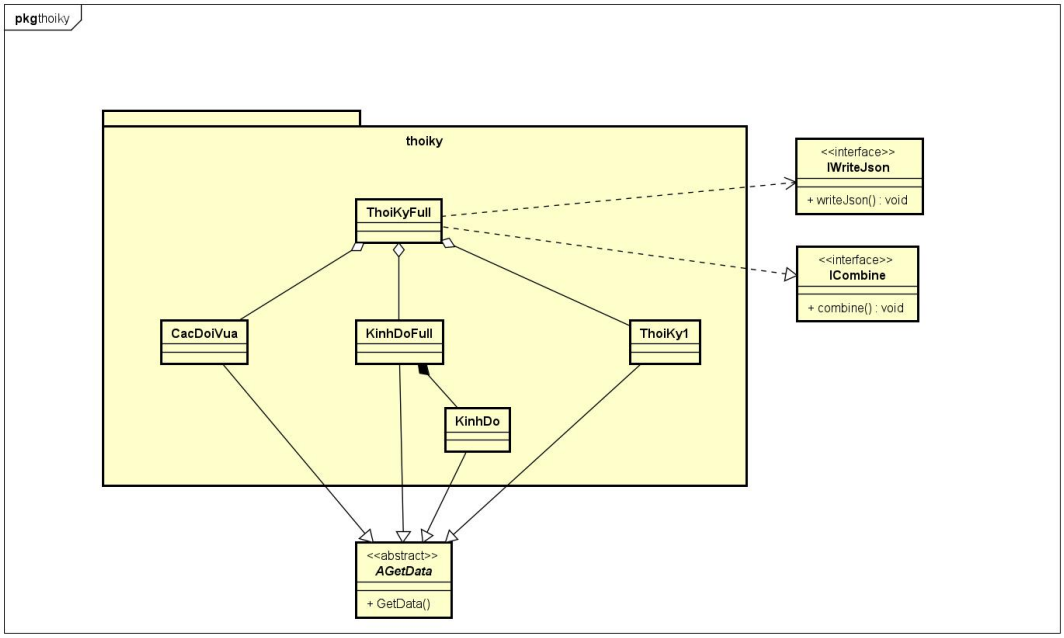


Figure 16 package crawler.thoiky class diagram

Class	Link to scrap data
CacDoiVua	https://www.wikiwand.com/vi/B%E1%BA%A3n_m%E1%BA%ABu:Danh_s%C3%A1ch_vua_v%C3%A0_ho%C3%A0ng_%C4%91%E1%BA%BF_Vi%E1%BB%87t_Nam
KinhDo	https://vi.wikipedia.org/wiki/Th%E1%BB%A7_%C4%91%C3%B4_Vi%E1%BB%87t_Nam
KinhDoFull	
ThoiKy1	https://nguoikesu.com/tu-lieu/bang-doi-chieu-cac-trieu-dai-viet-nam-va-cac-trieu-dai-trung-quoc

Figure 17 Link to scrap data "thoiky"

2.3. Package crawler.nhanvatlichsu

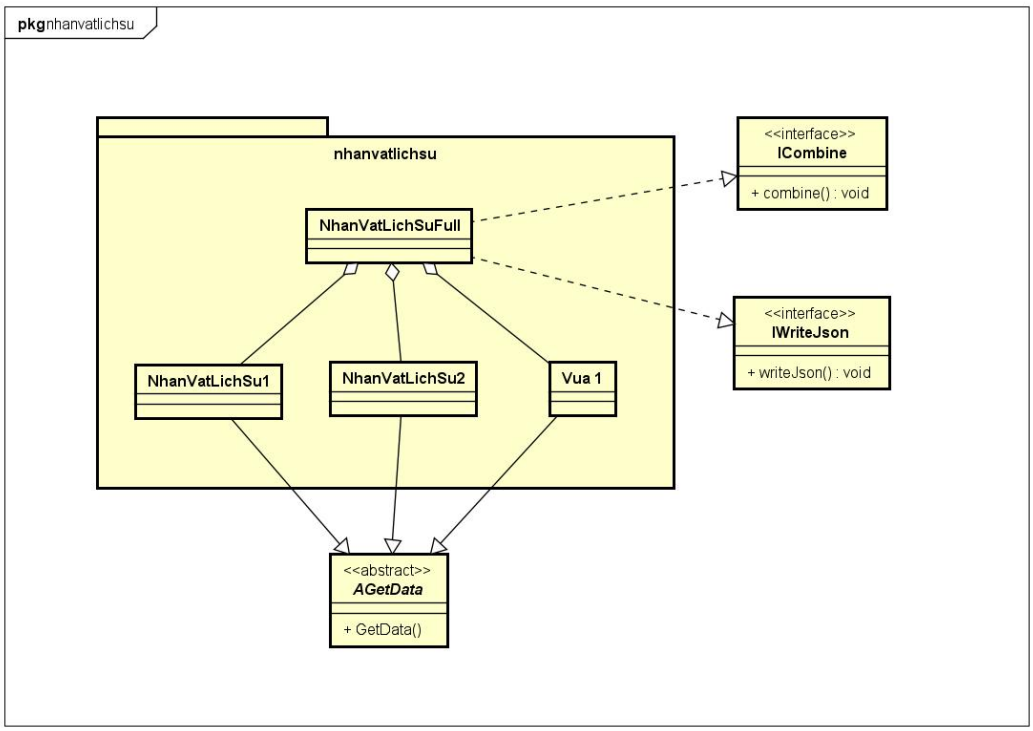


Figure 18 package crawler.nhanvatlichsu class diagram

Similar to “crawler.thoiky” package, for each website, a class was created to scrap data from that link and NhanVatLichSuFull served to combine all data from these links and covert it to Json file.

Class	Link to scrap data
NhanVatLichSu1	https://nguoikesu.com/nhan-vat
NhanVatLichSu2	https://vansu.vn/viet-nam/viet-nam-nhan-vat?page=0
Vua1	https://vi.wikipedia.org/wiki/Vua_Vi%E1%BB%87t_Nam

Figure 19 Link to scrap data "nhanvatlichsu"

2.4. Package crawler.sukienlichsu

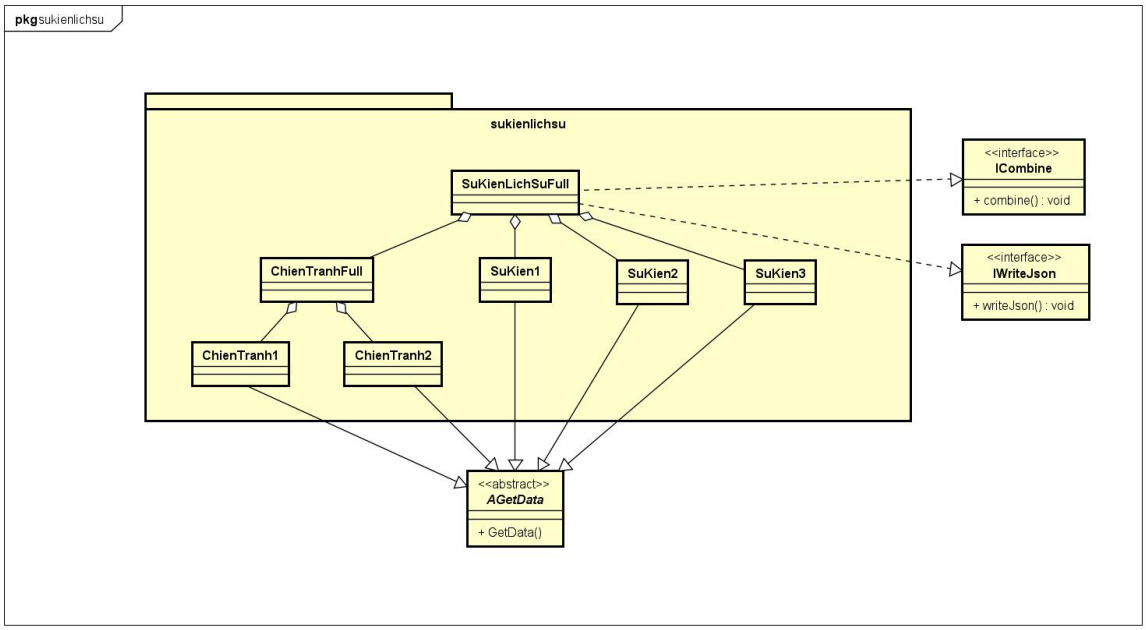


Figure 20 package crawler.sukienlichsu class diagram

In this crawler.sukienlichsu package, “ChienTranhFull” class serves to collect data from “ChienTranh1” and “ChienTranh2” classes, each of which collects data from different links. “SuKienLichSuFull” then collect data from “ChienTranhFull” and “SuKien1”, “SuKien2” and “SuKien3” data.

Websites to scrap data is shown as below.

Class	Link to scrap data
ChienTranh1	https://vi.m.wikipedia.org/wiki/C%C3%A1c_cu%E1%BB%99c_chi%E1%BA%BFn_tranh_Vi%E1%BB%87t_Nam_tham_gia
ChienTranh2	https://nguoikesu.com/tu-lieu/quan-su?filter_tag[0]=
SuKien1	https://vi.wikipedia.org/wiki/Ni%C3%AAn_bi%E1%BB%83u_1%E1%BB%8Bch_s%E1%BB%AD_Vi%E1%BB%87t_Nam
SuKien2	https://thuvienlichsu.com/category/su-kien/
SuKien3	https://nguoikesu.com/tu-lieu/quan-su

Figure 21 Links to scrap data "sukienlichsu"

2.5. Package crawler.ditichlichsu

For each website in two selected links, two classes “DiTich1” and “DiTich2” were created to scrap data from that link and DiTichFull served to combine all data from these links and covert it to Json file.

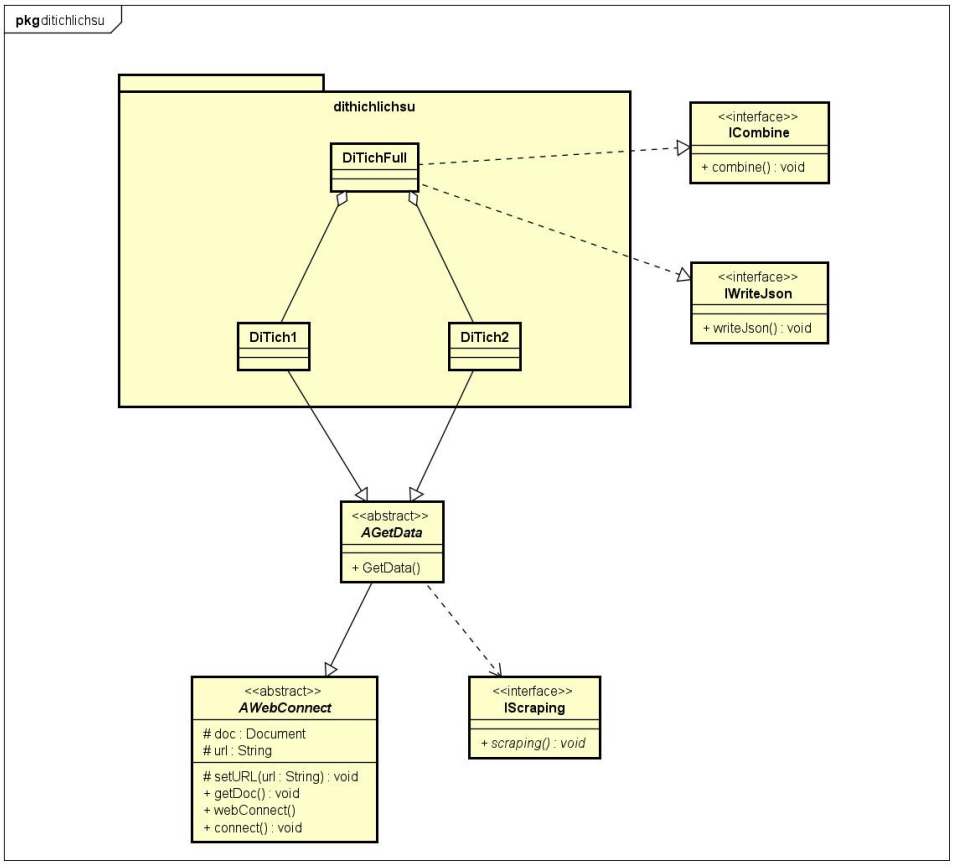


Figure 22 package "crawler.ditichlichsu" class diagram

Class	Link to scrap data
DiTich1	https://vi.m.wikipedia.org/wiki/Danh_s%C3%A1ch_Di_t%C3%ADch_qu%E1%BB%91c_gia_Vi%E1%BB%87t_Nam
DiTich2	http://ditich.vn/FrontEnd/DiTich/Form?do=&ItemId=6144

Figure 23 Link to scrap data "ditichlichsu"

2.6. Package crawler.lehoi

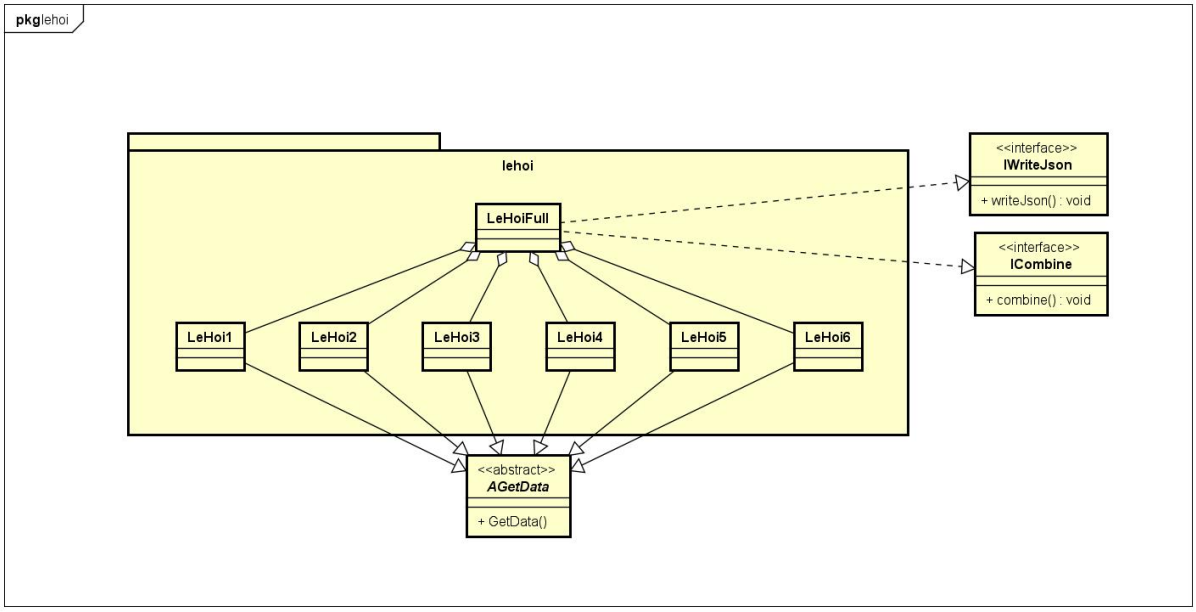


Figure 24 crawler.lehoi package class diagram

"crawler.lehoi" package diagram depicts "LeHoiFull" class and 6 others. In this package, "LeHoiFull" combines data from the other classes and converts it to Json file in folder "data".

Class	Link to scrap data
LeHoi1	https://vi.wikipedia.org/wiki/L%E1%BB%85_h%E1%BB%99i_Vi%E1%BB%87t_Nam
LeHoi2	https://angiangtourist.vn/thoi-gian-va-dia-diem-to-chuc-cac-le-hoi-lon-o-an-giang/#Tr
LeHoi3	https://dulichkhampha24.com/le-hoi-o-da-nang.html
LeHoi4	https://alltours.vn/tuyen-quang/cac-le-hoi-o-tuyen-quang.html
LeHoi5	https://vinpearl.com/vi/le-hoi-o-ha-nam-top-10-le-hoi-dac-sac-lon-nhat-trong-nam
LeHoi6	https://blog.mytour.vn/danh-muc/le-hoi-su-kien?page=1

Figure 25 links to scrap data "lehoi"

3. Package "application"

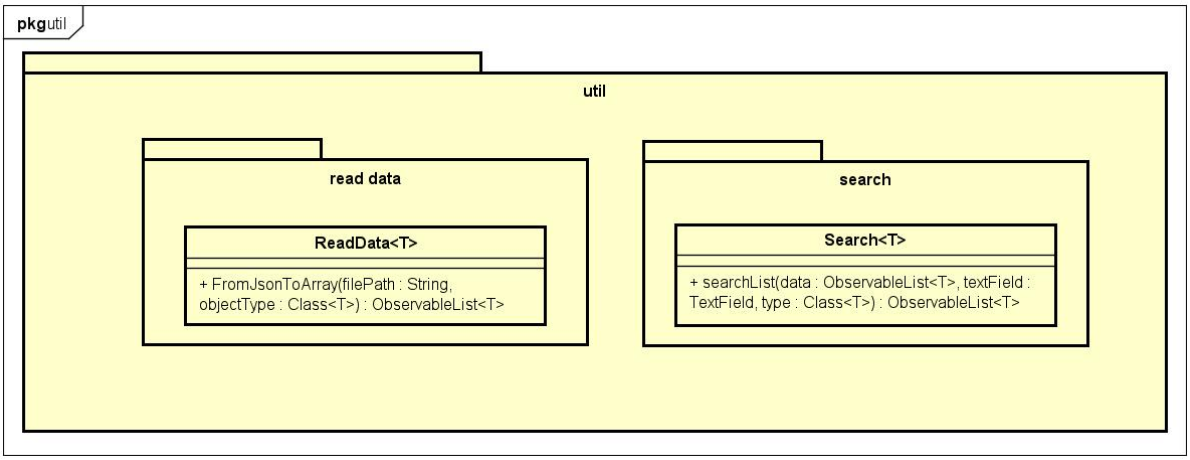


Figure 26 'application.util' package class diagram

The figure demonstrates details of 'application. util' package diagram. From above, util contains two smaller packages, each of which includes a class corresponding to one functionality that the application needs to run on or serve the end user.

'readdata' package contains 'ReadData' class. This class serves convert Json data from 'data' package to class in Java and convert it to ObservableList type then show it in the GUI.

While 'search' package includes 'Search' class. This helps 'searching' functionality. When a user types a keyword to find the data in the main board, this class finds the data in that table (case insensitive).

In general, these classes were called in 'Controller' class in 'application.main' package. In 'Controller.java' these classes are executing when an event is called, then return the results in the table or pop up the new panel which shows detail data of an object.

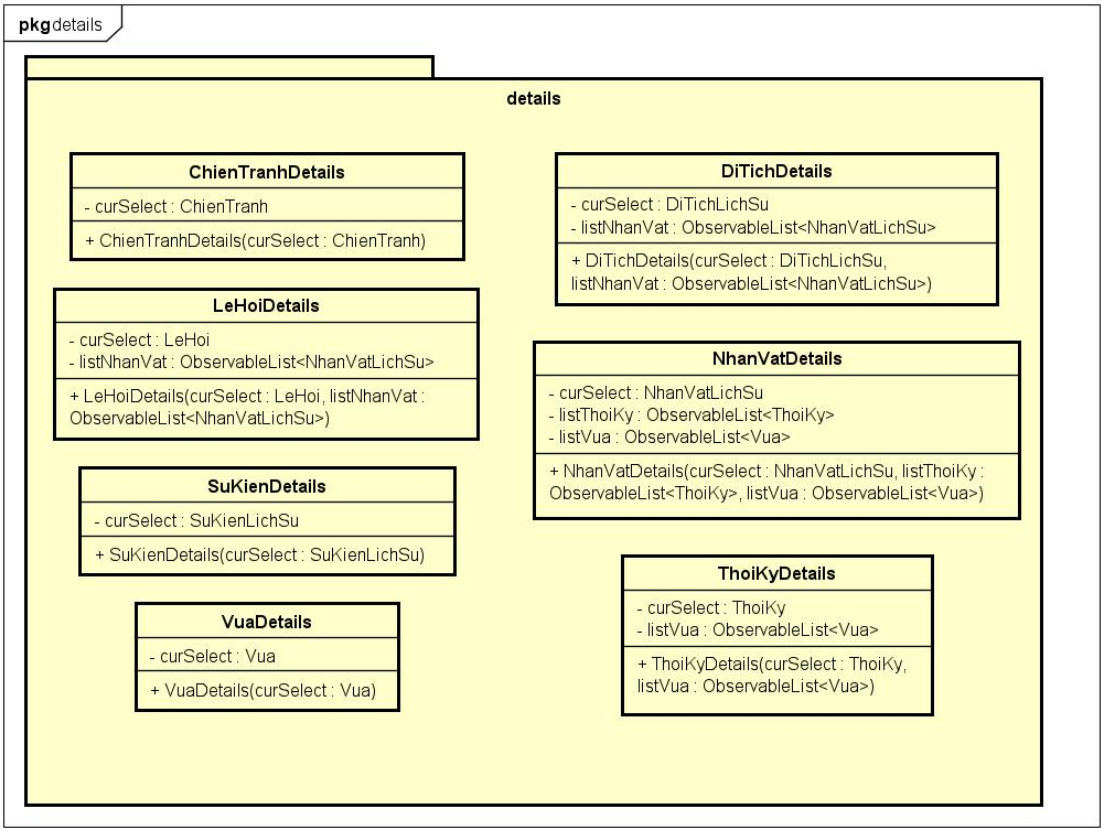


Figure 27 'application.details' class diagram

Those classes, which are in ‘application.details’ package, describe the detailed information about a specific object when the user double clicked to the name of that object in the final system. When executing, the ‘curSelect’ takes in the String then converts it to ‘Object’ type, then if it is matching, it will return the details of that.

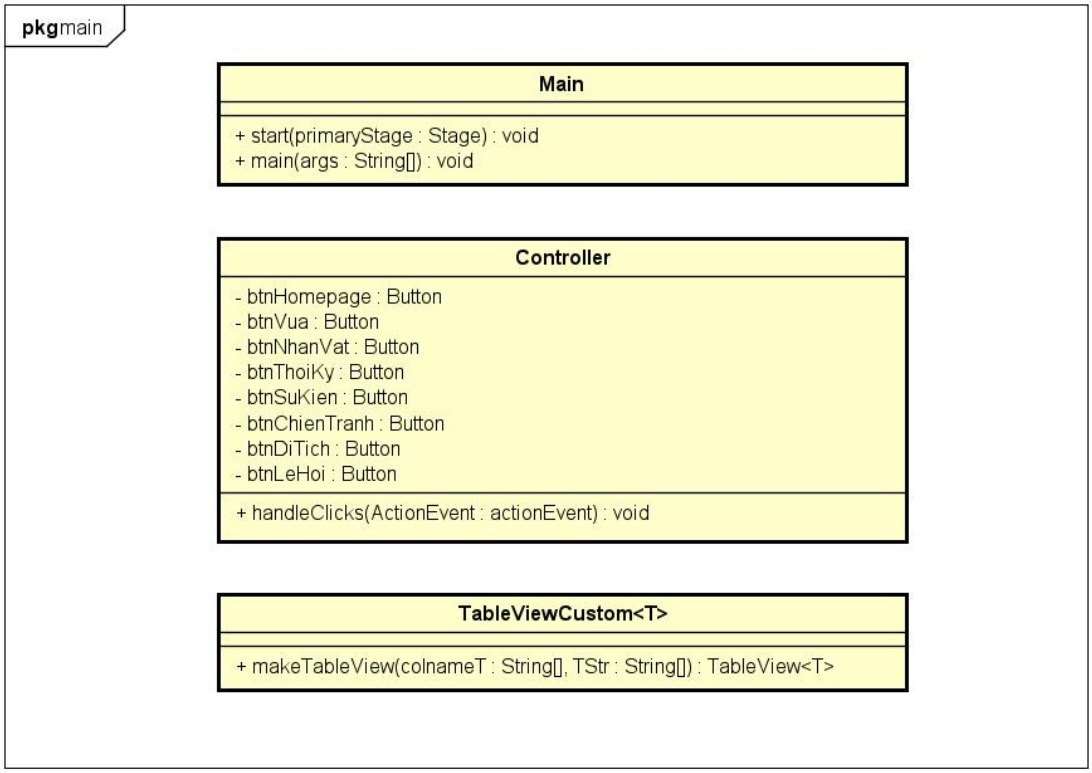


Figure 28 'application.main' class diagram

'application.main' package supplies all classes that we need to create the GUI and functionalities for the end users. 'Main.java', meanwhile, runs the final program, 'Controller.java' was used to handle the events and control the program. Class 'TableViewCustom.java' is setting the grapical interface of table view in the final program.

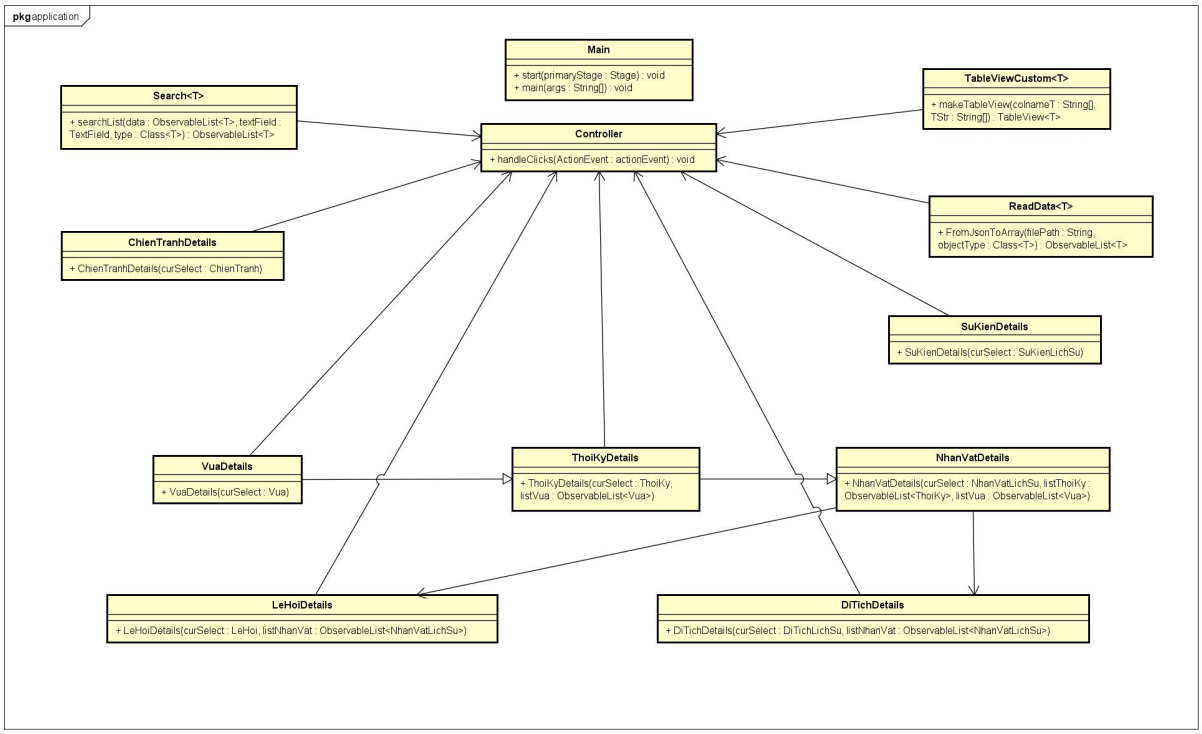


Figure 29 'application' class diagram

The above figure depicts the relationships and interations between all classes in package 'application'.

4. Data storing design

The JSON data files storing the collected data are in the 'data' package:

Json files	Objectives	Folder
thoiKy.json	stores dynasty data	data.thoiky
ChienTranh.json	stores war data	data.sukienlichsu
SuKien.json	stores historical event data	
nhanVatLichSu.json	stores historical figure data	data.nhanvatlichsu
vua.json	stores kings data	
DiTich.json	stores historical relic data	data.ditichlichsu
leHoi.json	stores festival data	data.lehoi

CHAPTER 5. RESULTS & PROGRAM TESTING

I. Statistics of data

Entites	Quantity
Dynasty (Thời kỳ)	22
Historical figure (Nhân vật lịch sử)	2368
King (Vua)	164
Historical event (Sự kiện lịch sử)	345
War (Chiến tranh)	283
Relic (Di tích lịch sử)	5684
Festival (Lễ hội)	318

Figure 30 Statistics of data

II. Final program testing

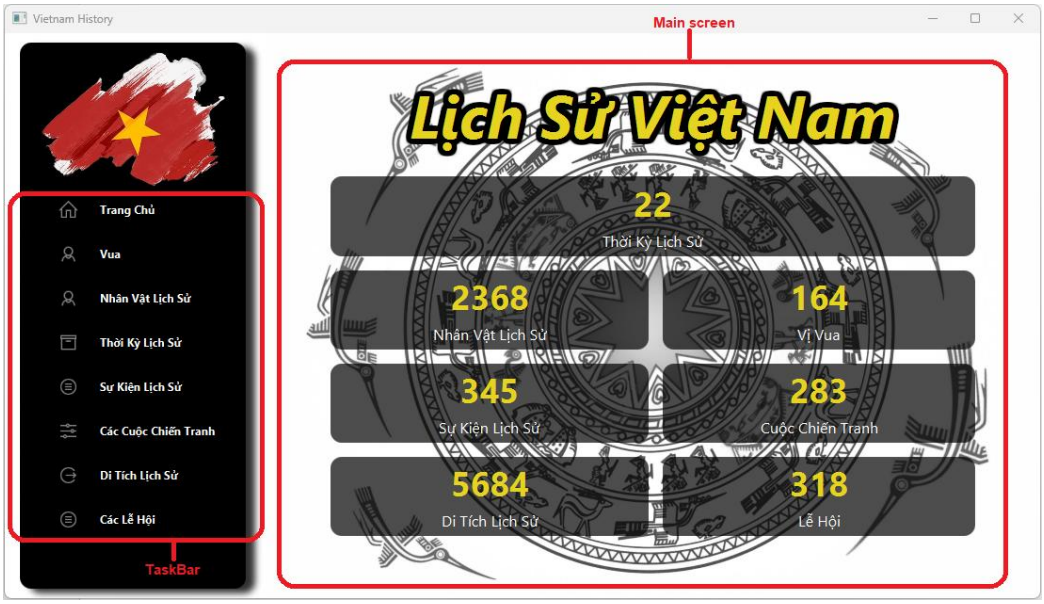


Figure 31 Main screen (Trang chủ)

Figure 32 King screen (Vua)

Figure 33 Historical figure screen (Nhân vật lịch sử)

Figure 34 Dynasty screen (Thời kỳ lịch sử)

Figure 35 Event screen (Sự kiện lịch sử)

Figure 36 War screen (Các cuộc chiến tranh)

Figure 37 Relic Screen (Di tích lịch sử)

Figure 38 Festival Screen (Các lễ hội)

Figure 39 Search Test

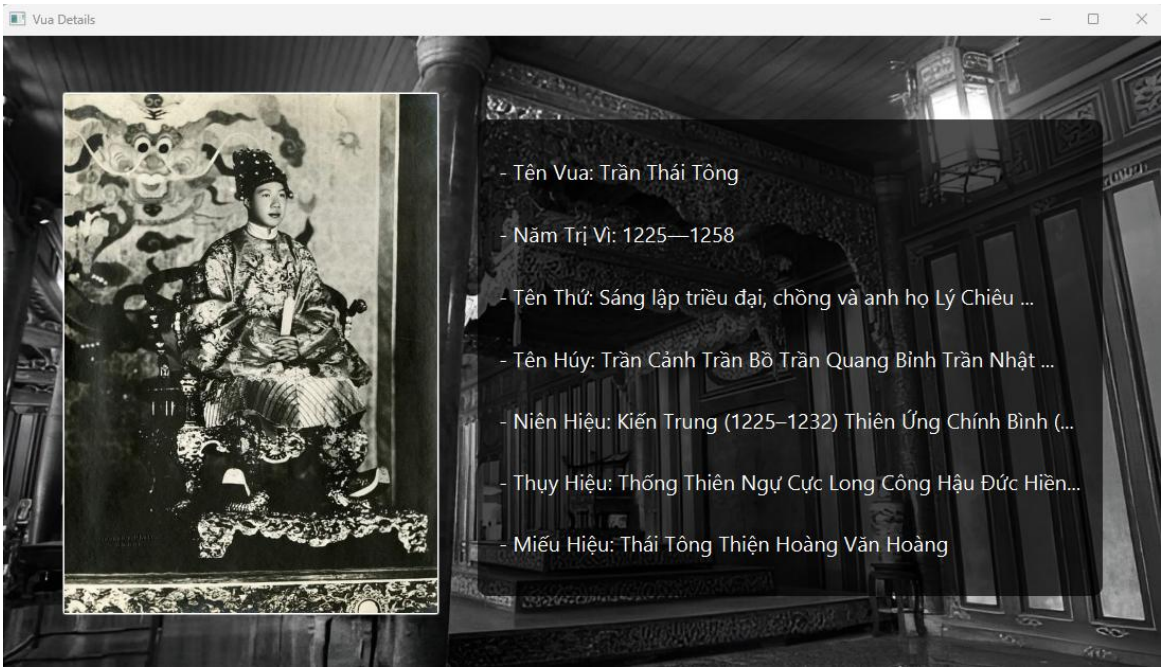


Figure 40 Details of Kings

CHAPTER 6. OOP TECHNIQUES IN USE

I. OOP Techniques

1. Encapsulation:

Properties are hidden using the private access modifier, and public methods are used to access and modify the data.

- Benefits: Ensures data security.

2. Inheritance:

In the data collection section, the program uses abstract classes and interfaces. The websites are created as separate classes and inherit from the abstract classes and interfaces.

In the program, single-level inheritance is used in the packages of entities, and multiple-level inheritance is used in the application.details package.

In many classes, the use of inheritance helps make the code more concise and readable. For example, when scraping data about dynasties, there is a ThoiKyFull class that calls different components such as name scraping and time scraping.

- Benefits: Inheritance facilitates rapid and concise programming.

3. Polymorphism:

Polymorphism is demonstrated in the program through the following points:

Method overloading is implemented in the classes of entities, allowing the creation of objects with different types of input parameters.

When classes inherit an interface, each class needs to override the methods defined in the interface.

- Benefits: Polymorphism allows writing a single method with multiple parameter types. Additionally, it enables customization of inherited methods to suit specific objects, such as collecting data from different websites in different ways.

4. Abstraction:

Abstraction is implemented through abstract classes and interfaces, with subsequent classes inheriting from them.

- Benefits: Abstracting common attributes of entities helps simplify and expedite programming.

5. Generic Programming:

Generics are used in the ReadData class, where the type of entity is passed as a parameter to the ReadData object to read information about that entity from a JSON file.

II. Algorithms:

The keys of the objects are stored in an ArrayList<String> to save memory space and to comfort the searching function. When information needs to be retrieved, a search is performed based on the key to that model.

CHAPTER 7. CONCLUSION & FUTURE DEVELOPMENT

During the process of completing our major project, we have relatively fulfilled the required functionalities to a satisfactory extent using object-oriented programming (OOP) techniques. We had detailed ideas and analyzed the project using object-oriented methods to build an overall model of the product. Based on that model, we implemented the programming according to the completed design. The system is forwarding two principles: high cohension, low coupling.

However, due to limitations in our work process and knowledge, our team made efforts to refine the product, but there are still some errors and incomplete features in the project. We have recognized these limitations and have a plan to address them.

In the near future, we plan to add new features to the product and improve the interface to provide a better user experience. We understand that a visually appealing and user-friendly interface will facilitate easy and convenient interaction with the product.

APPENDIX A. INSTRUCTION & TEAM CONTRIBUTION

To run the application, simply execute the main file within the Main.java class in the application.main package. After running the app, you can proceed to perform the predefined functions available in the app.

Here is the team contribution and evaluation thoroughout the project.

Member	Work	Score
Nguyen Trong Huy	- Project manager/owner - System design - Program design (crawler, model) - Implementation (crawler.thoiky, crawler.processfull, crawler.util) - Report writer	17%
Tran Duc Nam	- Prepare web sources - Program design (model, application) - GUI designer - Implementation (application) - Demo video preparation	17%
Trinh Giang Nam	- Do requirement analysis - Prepare web sources - Implementation (crawler.nhanvatlichsu, model) - Testing phase	17%
Bui Phuong Nam	- Do requirement analysis - Prepare web sources - Program design (crawler) - Implementation (crawler.ditichlichsu) - Testing phase	17%
Nguyen Chinh Minh	- Do requirement analysis - Prepare web sources - Implementation (crawler.sukienlichsu, model) - Testing phase	16%
Hoang Minh Quan	- Do requirement analysis - Prepare web sources - Implementation (crawler.lehoi) - Testing phase	16%

Figure 41 Team contribution

REFERENCES

[1] SOICT, Slides of OOP (IT3100E), Ha Noi: SOICT, HUST, 2023.

[2] ZenRows, "Web Scraping in Java in 2023: The Complete Guide," 19 December 2022. [Online]. Available: https://www.zenrows.com/blog/web-scraping-java#can-you-web-scrape-with-java. [Accessed 2023].

[3] Oracle, "Getting Started with JavaFX," September 2013. [Online]. Available: https://docs.oracle.com/javafx/2/get_started/jfxpub-get_started.pdf. [Accessed June 2023].

TABLE OF FIGURES