

**DEVELOPMENT OF HOTEL PRICE MONITORING APPLICATION USING
LOW CODE PLATFORM**

**BY
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ABSTRACT

This project is a hotel price monitoring application that uses a low-code platform to automate the process of collecting, analyzing, and reporting hotel pricing data. Online travel agencies (OTAs) have become popular nowadays due to traveling is good for mental health which promotes happiness and help us to take our mind off stressful situations. Travelers now search and compare room prices of hotels online, which is more convenient. For convenient and precise information on room prices, I propose a real-time monitoring system for hotel prices, allowing travelers to track changes in hotel information. The system records all prices and provides the data to our mobile phone. The project aims to enhance existing travel and hotel price monitoring services, helping users save time when booking hotels by providing accurate and up-to-date information on hotel prices.

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CHECK LISTS

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LIST OF ABBREVIATIONS

<i>OTA</i>	Online Travel Agency
<i>GUI</i>	Graphical User Interface
<i>OS</i>	Operating System
<i>SDLC</i>	System Development Life Cycle
<i>UI</i>	User Interface
<i>OOP</i>	Object-Oriented Programming

CHAPTER 1

Introduction

1.1 Problem Statement and Motivation

The Online Travel Agency is a very important tool for every traveler. When traveling, all travelers need to book a hotel, and there is a lot of useful Online Travel Agency in the world such as Agoda, Booking.com, etc. However, while most of the services provided by current Online Travel Agencies meet the expectations of the majority and bring satisfaction, they still face some potential setbacks. We will investigate and discuss the issues and challenges faced by current Online Travel Agencies and their users in the following sections. [1]

One of the problem statements in this project is that **The Users unable to instantly know the price changes**. Users may not receive instant notifications of discounts and promotions because some websites require them to manually visit the site for updates, while others send notifications via email. For an example, if the user rarely read emails, they may miss out on the sales and promotion. Besides that, some Hotel Monitoring websites will have their own mobile application and it will alert or notify us about the promotion but if we are comparing prices of different hotel through different mobile apps and it notify the news through different apps then it will confuse the user about which apps currently having promotion and which do not. To elaborate further, this problem arises from current Hotel Booking websites without mobile applications being unable to instantly alert users about promotions, while those with mobile applications can lead to user confusion due to the abundance of apps. [1]

Another problem statement pertains to **Price Fluctuations**. Hotel prices can fluctuate frequently due to factors such as seasonality, demand, and availability. This makes it difficult for travelers to find the best deals. This situation causes the users need to go to every hotel booking website to check hotel prices due to there are a lot of Hotel Booking websites such as Agoda, OYO, Trivago, etc. For example, a user needs to travel to Sapporo, Japan he has to go one website and check hotel prices and the other one, this may waste a lot of time and if there is promotion in between the user has to

CHAPTER 1 INTRODUCTION

check every website again to choose his or her preferable hotel. To summary about this problem would be that user need to visit all the Hotel Booking websites to check hotel prices which waste time.[1]

The motivation behind this project was to develop a **hotel price monitoring system that could monitor real-time prices**. It could improve the convenience of the user which want to do the booking action and planning the travel plan.

Additionally, the project was motivated by the fact that **although there is a lot of hotel monitoring system already exist, but the problem is there is too many**. While there are too many different hotels monitoring system and with the same hotel but different price due to the promotion of different website different system. Therefore, it was uncommon to see a monitoring system that conclude most of the hotels monitoring system in one hotel price monitoring system.

Furthermore, the project aimed to **automate the task of checking hotels price by surfing different hotels monitoring system by using Node-Red**. This provides users with the convenience of accessing all the information they need through a single website, specifically the Node-Red Web UI.

1.2 Project Objectives

The main objective of this proposed project is to develop a hotel price monitoring system that could assist travelers using Node-Red Web UI and Telegram. It aims to make the user more convenient on checking hotel prices and news of promotion.

Moreover, the project was to automate the task of checking hotel prices by using Low code Platform (Node-RED), to reduce the time for each user while maintained the accuracy of the results.

The sub-objectives of the project are as follow:

- To allow users to track hotel prices in real-time and scrape it correctly, allowing hotel revenue managers and travelers to make informed decisions based on the most up-to-date pricing information.
- To develop a system that able to collect pricing data from various sources, such as hotel websites, online travel agencies, and other booking channels, to provide a comprehensive view of the market.
- To develop a hotel price monitoring system that able to handle large volumes of data and provide fast and reliable performance.

1.3 Project Scope

The project scope is to develop a hotel price monitoring system to monitor hotel prices of all the hotel. It also enables users to check the prices whenever they want with real-time data. The system has several features. Firstly, the system will get the hotel data such as hotel price, name, discounted price, etc., by using Selenium library which is a library inside Node-Red. After obtaining the hotel data, the system will send it to the Node-Red Web UI and Telegram. The user can view the data through the Node-Red Web UI and Telegram. Furthermore, the user will not need to go through several apps to compare hotel prices, as it can check the hotel price by keying command to Telegram bot at the same time, the most up-to-date pricing information will be provided. In addition, when user need to book a hotel, the user only needs to go to the Node-Red Web UI, and then all the hotel prices of the place will be show on Node-RED Web UI which can save the time of the users.

1.4 Main Contributions from the Project

In this project, we will provide convenience and an advance yet simple to access method for the users, so that the user will not need to go through several apps to compare hotel prices, the user only needs to go to the Node-Red Web UI, then all the hotel price of the place will be show on Node-Red Web UI which can save the time of the users and enhances user adoption and satisfaction.

From this project, we also want to make the user more convenience on checking hotel prices by using Telegram bot by keying command to get the most up-to-date pricing information. Since nowadays smartphone became one of our daily necessities, the users or travelers can rely on Telegram to get all the hotel details needed.

We also know that traveling is good for mental health which promotes happiness and helps us to take our mind off stressful situations. Hence, the system wants to make convenient for the user when user making traveling plans. Therefore, we want all the user to have more confidence on the system throughout this project.

CHAPTER 1 INTRODUCTION

1.5 Report Organization

The chapter 1 of the project is Introduction. This section includes the Motivation and Problem Statement, Project Objectives, Project Scope, Main Contribution of the Report and Organization of the Report.

Chapter 2 of the project is Literature Review which is more on discussing the Review of Technologies and Review of the Existing System.

Chapter 3 of the project is System Methodology which consists of system development models, selected system development models, all the requirements of the system, expected system performance, expected challenges, project milestone and estimated cost.

Chapter 4 of the project is System Design which show the system architecture, functional modules in the system, system flow and GUI Design.

Last by not least, Chapter 5 is to do the conclusion for the system.

CHAPTER 2

Literature Reviews

2.1 Review of the Technologies

Technology decisions have a big impact in today's interconnected society. In this review, the foundations of the contemporary digital landscape, encompassing software platforms, operating systems, programming languages, and web scraping tools are elucidated. To facilitate comprehension of the complexity of current technology, an examination of their advantages, roles, backgrounds, and disadvantages is conducted. This review aspires to serve as a guide, offering insights and recommendations in the ever-evolving landscape of technology.

2.1.1 Software Platform

2.1.1.1 Node.js



Figure 2.1.1.1-1: Logo of Node.js

Node.js is an open source, cross-platform that allows developers to perform server-side JavaScript development. It was first released in 2009 and had become one of the most popular tools and some of the programming tools also built on top of Node.js such as Node-RED. Node.js is usually used for running JavaScript code and due to it also including a range of built-in modules and libraries such as HTTP and HTTPS modules that make it is easy to build web servers and web applications.[9]

Moreover, Node.js is based on JavaScript; therefore, many developers already familiar with the structure and syntax of Node.js. Because of this Node.js has a large and active community of developers who have contributed to a wide range of third-party libraries which make Node.js become a powerful tool for applications.

2.1.1.2 Node-Red (Low Code Platform)

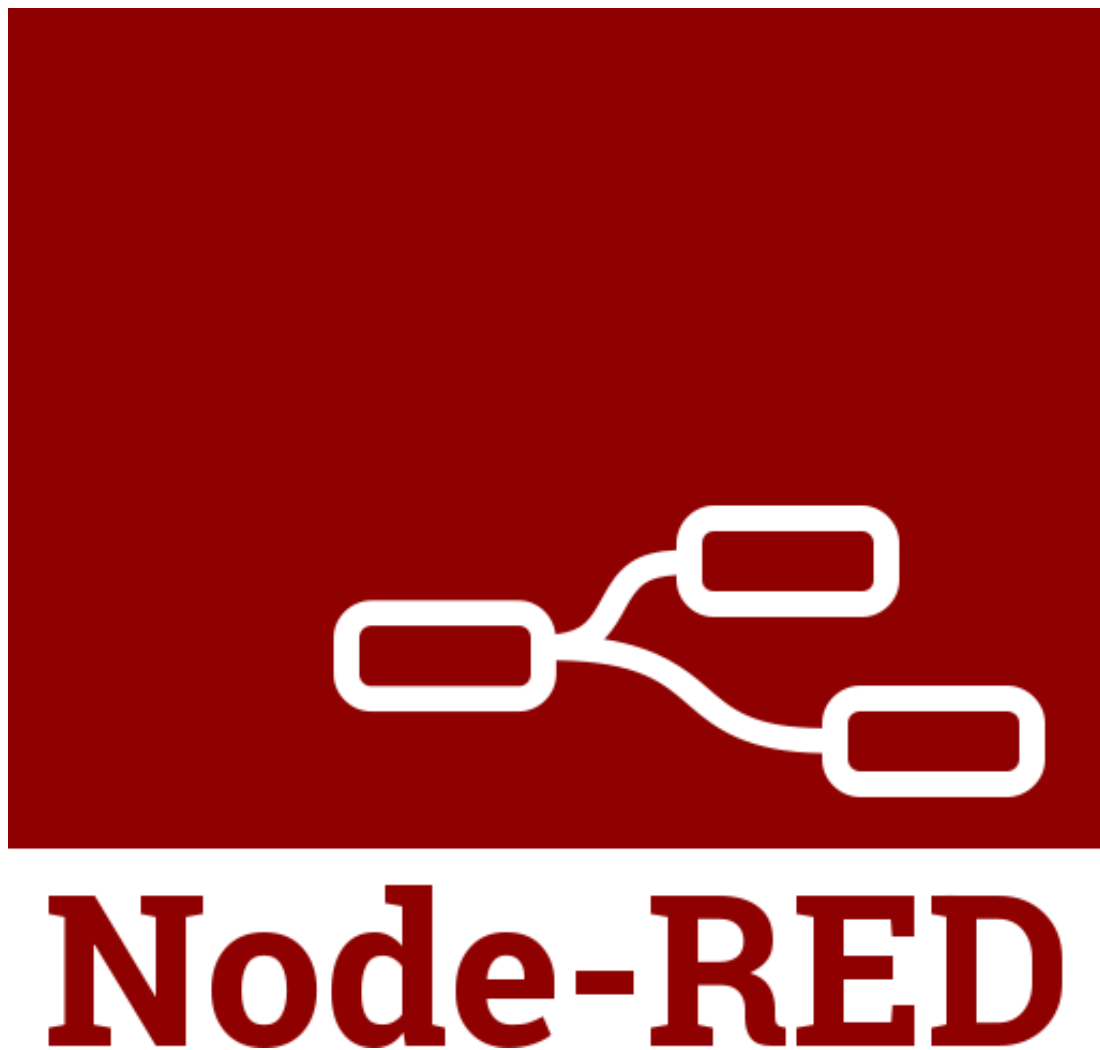


Figure 2.1.1.2-1: Node-RED

Node-RED is developed by the IBM Emerging Technology and is now maintained by the Node-RED project. Node-RED is built on top of Node.js. It is a programming tool that provides a simple drag-and drop interface which allows users to create flows by wiring the nodes together. It can perform a wide range of tasks, such as data processing, database integration etc. [2]

CHAPTER 2 LITERATURE REVIEW

Following are the some of the library inside the Node-RED that we can install and use for our development:

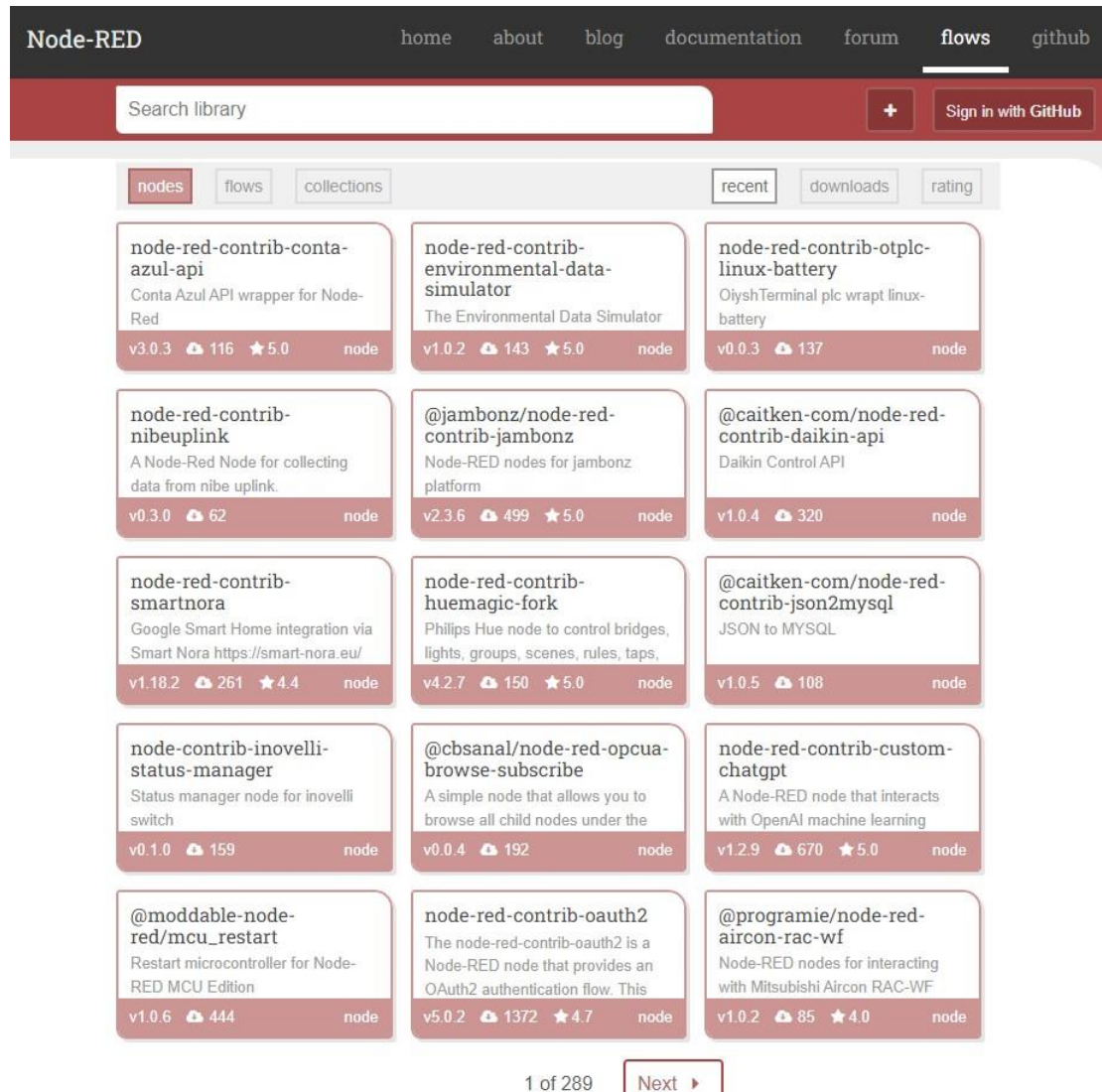


Figure 2.1.1.2-2: Node-RED's libraries

There are a lot of libraries inside the Node-RED which allow us to improve our development. [2] For an example, “node-red-contrib-selenium-webdriver (node)” which can help us to request and receive the data from the website we want. Besides, “node-red-dashboard (node)” which can help us to design our UI. Lastly, “node-red-contrib-telegrambot” enable us to perform development through Telegram.

2.1.1.3 Django(web framework)



Figure 2.1.1.3-1: Logo of Django(web framework)

Django is an open-source web framework that is used to write Python that enables clean, scalable, and rapid development. It follows the Model-View-Template (MVT) architectural pattern, which is slightly different with the Model-View-Controller (MVC) pattern, providing the developers with a wide range of libraries to simplify the process of the web development. [13] Moreover, it also provides many features which can easily simplify the development, as well as a huge and active community that continuously developing and updating the web framework. Due to its efficiency, Django has become a popular choice among developers that need to use Python as the main programming language for web application development.

2.1.2 Firmware/OS

2.1.2.1 Windows



Figure 2.1.2.1-1: Logo of Windows

Due to Node-RED is a programming tool that can be installed and run on cross-platform, it can also run on Windows too. Node-RED can run on Windows 7,8 and 10. Windows is nowadays the most widely used operating system (OS) developed by Microsoft Corporation. Windows has its own Graphical User Interface (GUI) that allows users to interact with the system using icons and menus. In Windows, it allows users to use the software applications due to it supports a wide range of software applications such as the one we going to use, Node-RED for software development. [3]

Therefore, Windows is more convenience to use when developing the hotel prices monitoring system due to it is easier to perform installation and it also provide a range of security measures such as Windows Defender, which help protect against malwares.

2.1.2.2 Linux



Figure 2.1.2.2-1: Logo of Linux

Linux is a free and open-source operating system based on the Unix operating system. It is a popular OS known for its flexibility, allowing users to choose from a wide range of software application or software packages to create a system. [12]

Other than that, Linux is also known for its command-line interface. This allows users to install application not using all those setup file but use command lines to install. Linux also has a large and active community of developers who contribute to the improvement of the operating system. This means that we can find solutions in the community support.

2.1.2.3 MacOS



Figure 2.1.2.3-1: Logo of MacOS

MacOS is the operating system developed by Apple Inc and is built on a Unix-based foundation called Darwin kernel which is an open-source operating system but macOS is not an open-source OS. It is a popular OS due to its user-friendly interface, stability, and smooth performance. Moreover, macOS has a very good security because it less targeted by malware and viruses to compare with other OSs, which helps to protect users' data. Other than that, macOS ensures a seamless integration between macOS and their Apple devices like iPhones, iPads etc. that leads the OS to a smoother user experience. [14]

MacOS can support various programming languages due to its Unix-based foundation, so Node-RED can also be used in macOS. Unfortunately, some specialized software is not available for macOS; therefore, Windows still the primarily choice for some developers.

CHAPTER 2 LITERATURE REVIEW

2.1.3 Programming Language

2.1.3.1 Python

Python is a high-level programming language with many libraries available, making it easy to use for accomplishing complex tasks. Python is also cross-platform, just like Node-RED, which means that it can be run on Windows, macOS, and Linux.

Python is a language that designed to be easy to read and use, much like the English language, which make it is widely used at software development and web development.

2.1.3.2 JavaScript

JavaScript is a high-level programming language, and due to its dynamic features, it is widely used in web development. JavaScript is widely used in front-end web development, where it is used to create handle user input, user interfaces etc. Besides, it is also used in a wide range of applications such as web applications and mobile applications, not only in front-end web development.

JavaScript also support event-driven programming, which means that it can be used to respond to user actions such as mouse clicks, making it an ideal tool for creating web applications.

2.1.3.3 Java

Java is a high-level, object-oriented programming language and due to its flexibility and robustness it become one of the most famous and widely used programming languages in the world. Java comes with a library (Java Standard Edition – Java SE) that provides a wide range of pre-built classes and packages for tasks like file handling, database connectivity, networking, etc., simplifying the process of development.

Moreover, Java is a pure OOP language, which means that in Java, everything is an object. Java uses the 4 pillars of OOP which are encapsulation, inheritance, polymorphism, and abstraction to help the developers to create efficient software systems.

2.1.4 Web Scraping Tool

2.1.4.1 Selenium WebDriver



Figure 2.1.4.1-1: Logo of Selenium WebDriver

Selenium WebDriver is an open-source tool for developers to write scripts in a programming language to automate browser actions and navigate between pages. It is designed to work with multiple browsers such as Google Chrome, Mozilla Firefox, and Microsoft Edge. [11]

Selenium WebDriver has several abilities such as locating web page elements, handling user input, and processing the response from the web server, which can be used for web scraping and data extraction. Selenium WebDriver can extract data from the websites and save it in a structured format, such as JSON.

Moreover, Selenium WebDriver supports multiple programming languages such as JavaScript, Python, Java, C# and Ruby. Additionally, it includes advanced browser automation features for AJAX-based applications and advanced selectors for locating elements on a web page. [11]

One of the weaknesses that Selenium WebDriver has is that it is will be difficult to understand.

2.1.4.2 Octoparse



Figure 2.1.4.2-1: Logo of Octoparse

Octoparse is a web scraping software that allows users to perform web scraping and extract data from websites. [4] If the user without any coding skills or programming knowledge, Octoparse also provides a user-friendly interface that enable the users to perform web scraping. The interface is a point-and-click interface that allow user can identify the data they want to scrape. It also supports a wide range of data format including JSON, XLS, CSV and HTML.[10]

However, although this web scraping software provides some useful features, it requires payment costing \$89 to \$249 per month.

2.1.4.3 ParseHub



Figure 2.1.4.3-1: Logo of ParseHub

ParseHub is a powerful and user-friendly no code web scraping tool that similar like Octoparse, which is used to extract data from websites even though users without any coding knowledge. Similar to Octoparse, ParseHub also provides a point-and-click interface that allows users to extract data and perform web scraping by simply clicking on the elements. ParseHub can extract data from websites that use JavaScript and AJAX, which means it can handle dynamic websites. Once the data is extracted, it also offers various export options, including CSV, Excel, Google Sheets and JSON. [15]

Moreover, ParseHub also provides API Access, but it comes with a high monthly cost, which can be quite expensive.

CHAPTER 2 LITERATURE REVIEW

2.1.5 Summary of the Technologies Review

For the software, firmware/OS, programming language and algorithm have been reviewed. The following are the summarization in the Table 2.1.5-1.

Table 2.1.5-1: Summary of Technologies Review

Software Platform			
Software	Node.js	Node-RED	Django
Background	- Open source and cross-platform that focus on server-side JavaScript.	- Built on top of Node.js	- open-source web framework that use to write Python
Usage	- For running JavaScript code - Provide built-in libraries to build web servers and web applications	- Programming tool that provide drag-and drop interface to create flow by wiring nodes together	- provide a wide range of libraries to simplify the process of the web development - For developing using Python

Firmware/OS			
OS	Windows	Linux	macOS
Background	- Proprietary operating system developed by Microsoft Corporation	- Open-source operating system	- OS developed by Apple Inc and built on Unix-based foundation.
GUI	Yes	Yes	Yes
Special	- Support wide range of software applications	- Open-source OS - Huge community	- Support various programming languages - Smooth performance

Programming Language			
Language	Python	JavaScript	Java
Programming Language Type	High level with extensive support libraries	High level with extensive support libraries	High level with extensive support libraries
Usage	- Web development - Software development	- Web applications - Mobile applications - Front-end web development	- Web development - Mobile App development - Internet of Things (IoT)

CHAPTER 2 LITERATURE REVIEW

Web Scraping Tool			
Web Scraping Tool	Selenium WebDriver	Octoparse	ParseHub
Background	Open-source tool to automate web browser actions	Web scraping software for data extraction and web scraping	Web scraping tool for data extraction and web scraping
Advantages	<ul style="list-style-type: none"> - Locating web page elements - Handling user input - Processing response from the web server - Extract data into a structural form, JSON - Support multiple languages (JavaScript, Python, Java, C# and Ruby) - Include advanced browser automation which is the AJAX-based applications and advanced selectors 	<ul style="list-style-type: none"> - Provide a point-and click interface for user that without programming knowledge also can web scrape. - Support multiple data formats such as JSON, XLS, CSV and HTML. 	<ul style="list-style-type: none"> - Provide a point-and click interface for user that without programming knowledge also can web scrape. - Can extract dynamic websites - Support multiple export options such as CSV, Excel, Google Sheets and JSON - Provides API Access
Disadvantages	Hard to understand	Expensive	Expensive

2.2 Review of the Existing Systems

In the digital age of travel, hotel monitoring systems have become essential guides for travelers. In this review, guidance is offered on hotels monitoring websites, showing their function in assisting travelers by providing useful information - ranging from price comparisons to user reviews - and aiding hotels in achieving visitors' expectations. The objective is to provide a clear guide by exploring the features, usability, and impact for travelers seeking the ideal hotel.

2.2.1 Google Map

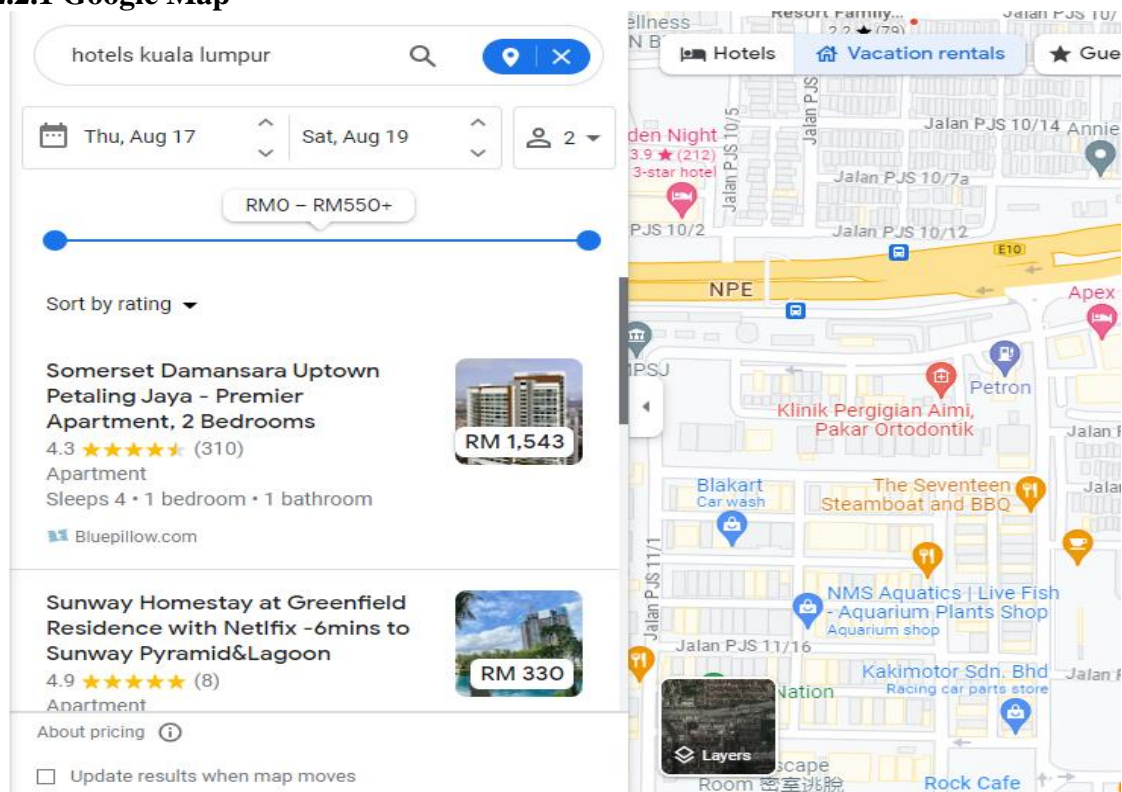


Figure 2.2.1-1 Google Map searching results

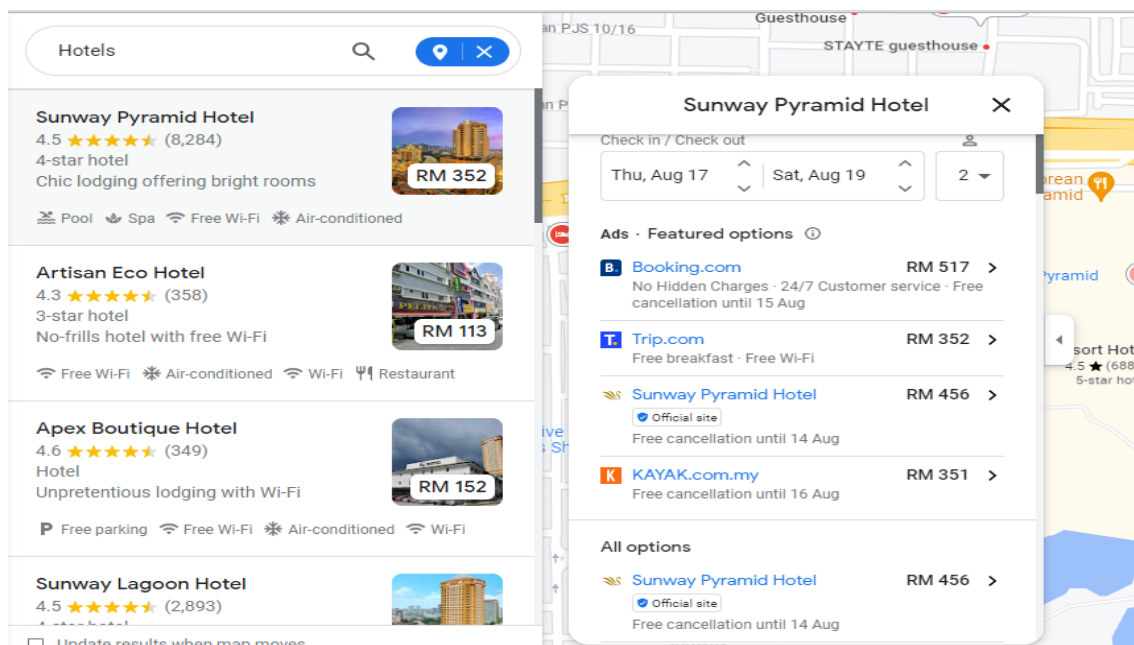


Figure 2.2.1-2 Search result of Google Map after choosing your location, check in and check out date and number of guests

Google Map is a very useful tools often used by users as GPS usage, which allows users to navigate locations worldwide. However, Google Map can used for the hotel monitoring, as shown in the picture above. It comes with the following features and advantages.

Since Google Map is a web mapping service, users can easily know that the hotels have any nearby facilities such as restaurants, convenience stores, etc. Therefore, when the travelers need to make travel planning, they can easily make a proper plan before booking the hotels. Moreover, the travelers also can use it as a GPS as mentioned above, so that even though the hotel is the first-time booking hotel also can go there easily. Furthermore, the OTA provide by the Google Map can easily redirect the users to the respective webpage to perform booking and to make further understanding by just one click on the OTA names.

Despite its many advantages, there are still have limitation in the system. One of its weakness and limitation will be that it only has two sorting system for users which is relevance and rating, which makes the users cannot sort even details on the hotels such as prices. Besides that, it has a very messy user interface, and it is widely known that a clean interface is required for users.

2.2.2 Cheapflights

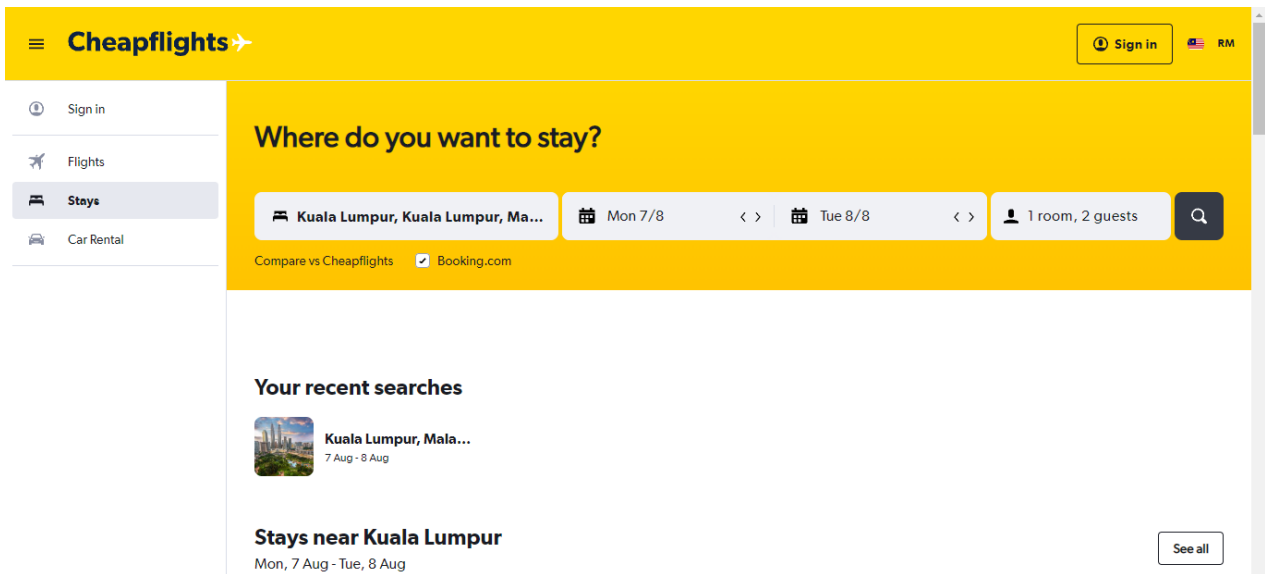


Figure 2.2.2-1 Homepage of Cheapflights

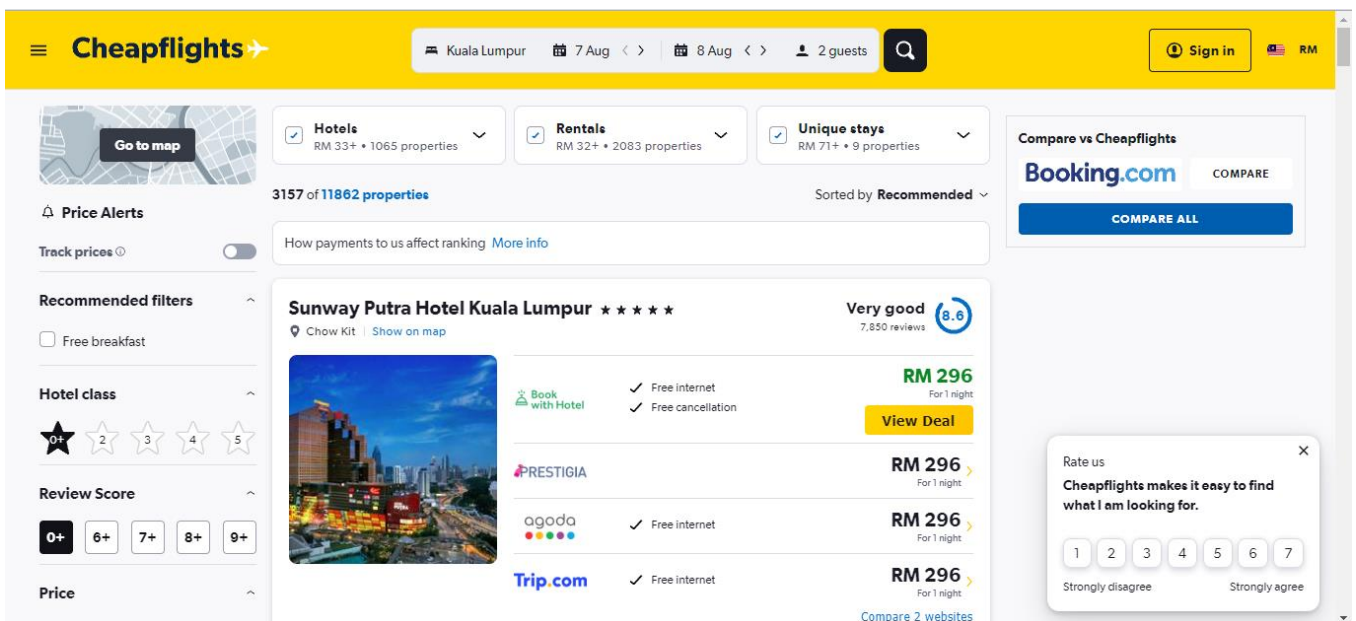


Figure 2.2.2-2 Search result of Cheapflights

CHAPTER 2 LITERATURE REVIEW

Cheapflights is a well-known hotel monitoring system that recommends high-quality hotels, car rentals, flights, and accommodations to customers. It offers the following features and advantages.

One of its obvious strengths is its clean and straightforward user interface. To elaborate on this strength mentioned earlier, the user interface is the first thing a user encounters when searching for a hotel to stay in. If the interface is cluttered, the user may have to spend more time searching for a hotel that meets their needs. Therefore, a clean and simple user interface will help the user save time spent searching for the best hotel.

Although there are many advantages, there are hardly any weaknesses or limitations in the system, as it is well-built. The only limitation worth discussing is the presence of a cold start problem. For newly registered users, the system recommends results generally preferred by other users but with prices.

2.2.3 Kayak

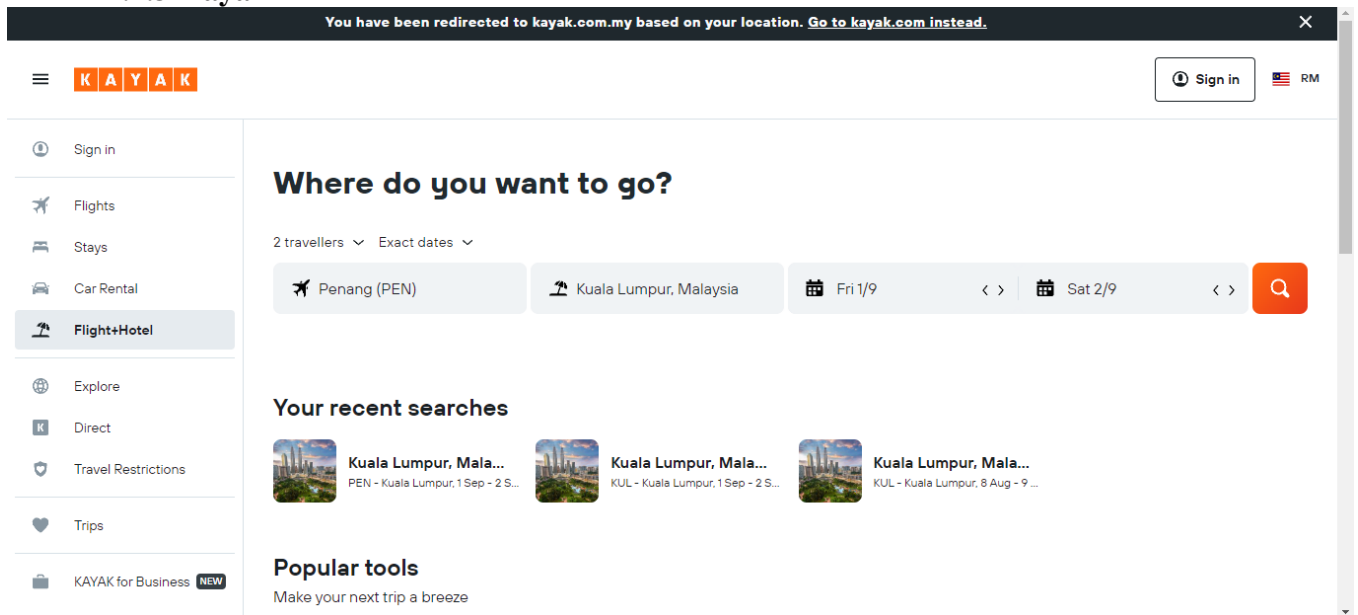


Figure 2.2.3-1 Homepage of Kayak

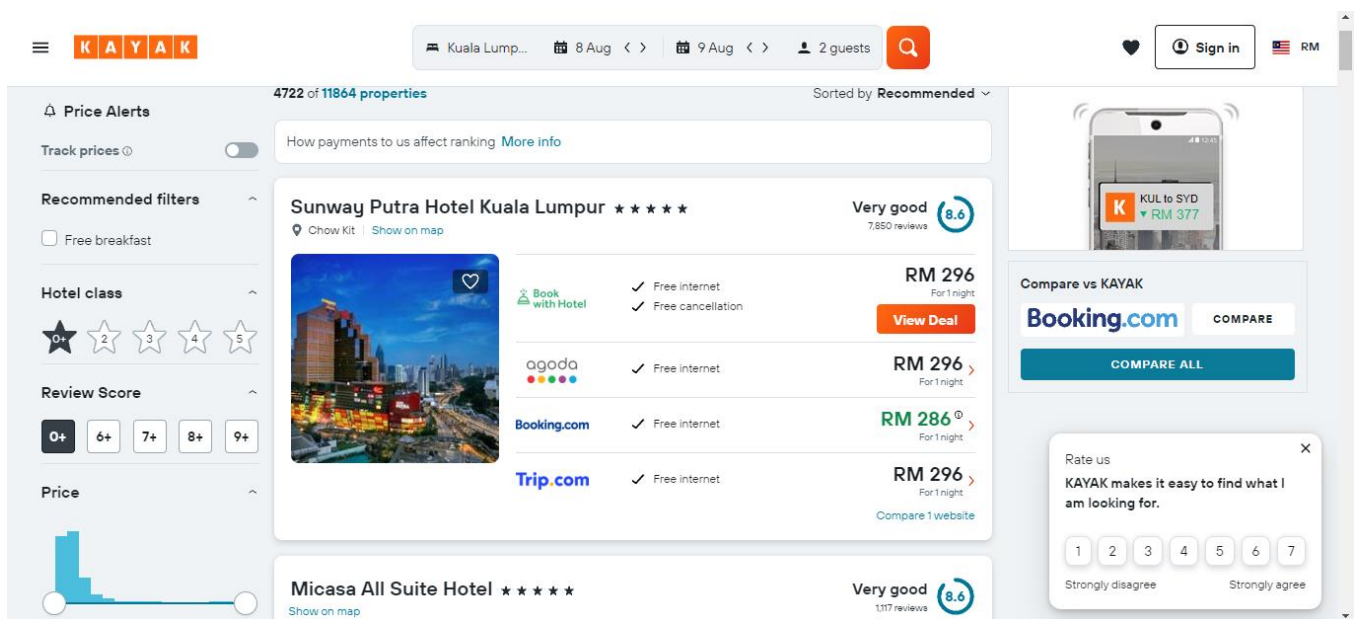


Figure 2.2.3-2 Search result of Kayak after choosing your location, check in and check out date and number of guests

CHAPTER 2 LITERATURE REVIEW

Kayak is a well-known online travel agencies (OTA) that uses a monitoring system to provide users with a large amount of hotel results based on the set of data inserted into the search engine, including location, check in and out dates, and the number of guests. Kayak, as a hotel monitoring system widely used by many travelers as well as businessmen who frequently travel for business.

Therefore, there are some features and advantages. One of them is Kayak will provide users with a simple search method to look for the ideal hotel that fits the users' preferences and satisfaction. This is one of the methods Kayak uses to overcome synonym problem that often happens to most user with this function or algorithm built into the system, users don't have to worry what keyword to use the ideal hotel for reservations.

Although there are many advantages, there are still have limitation in the system. The weakness and limitation of this method is that the user is limited to only searching for hotel by areas and price range only. If the user has a strong concept on what kind of hotel he wanted to stay in, it will take him quite an amount of time to go one by one to look for the preferable hotel.

2.2.4 TripAdvisor

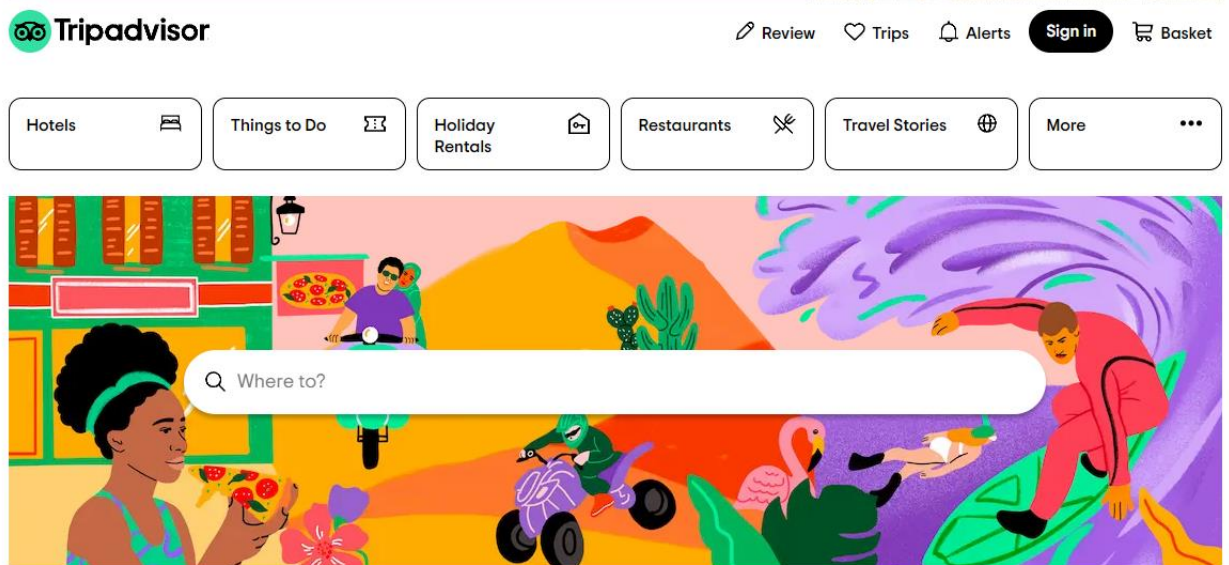


Figure 2.2.4-1 Homepage of TripAdvisor

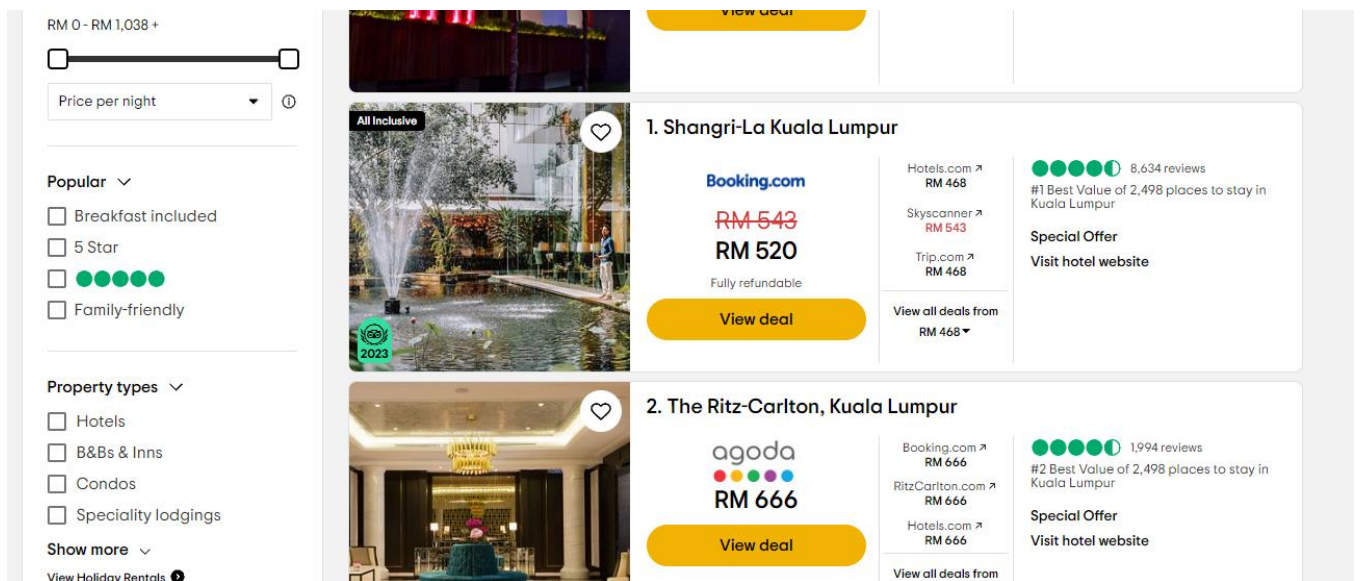


Figure 2.2.4-2 Search result of TripAdvisor after choosing your location, check in and check out date and number of guests

CHAPTER 2 LITERATURE REVIEW

TripAdvisor is one of the online travel agencies (OTA), it specializes in booking hotels, flights, and other travel-related services for customers worldwide. The company offers a wide selection of properties, including hotels, resorts, private villas, apartments, and vacation homestays rentals, and operates in over 200 countries. It comes with the following features and advantages.

The strength of this website is that users can search for hotels or homestays that they like using keywords. A search bar will be provided for the user to enter keywords and look for their desired hotel. This is a very useful and necessary feature that can be implemented into the proposed project, which is a hostel rental recommendation system. Moreover, TripAdvisor also have several filters that allow users to sort the results after searching with the data they've entered.

Although there are many advantages, there are still have limitation in the system. One of the weakness and limitation identified by TripAdvisor's hotel monitoring system is a synonym problem. When a user enters keywords to search for a specific hotel, the system may display several other results that are not related to what the user was looking for. Because the meaning of the words is similar, the system identified them as the same category and incorrectly displayed in the results. To resolve this kind of problem, TripAdvisor can mention in the results which are the same as the keyword searched by the user and mention those that are similar to the keyword differently.

CHAPTER 2 LITERATURE REVIEW

2.2.5 Summary of the Existing Systems

For the existing system for this project, there are 5 system have been reviewed. The following are the summarization in the Table 2.2.5-1.

Table 2.2.5-1: Summarization of the existing systems

Existing System	Advantages	Disadvantages	Critical Comments
Google Map	<ul style="list-style-type: none">- Easily know that the hotels have any nearby facilities such as restaurants, convenience stores, etc.- Easily make a proper plan before booking the hotels- Travelers also can use it as a GPS as mentioned above, so that even though the hotel is the first-time booking hotel also can go there easily- Easily redirect the users to the respective webpage to perform booking and to make further understanding by just one click on the OTA names.	<ul style="list-style-type: none">- Bad UI Design- Less sorting system	<ul style="list-style-type: none">- Will make the user feel difficult when performing the booking hotels and checking hotel price
Cheapflights	<ul style="list-style-type: none">- Clean and straightforward user interface	<ul style="list-style-type: none">- Presence of cold start problem	<ul style="list-style-type: none">- Will only recommend results that are generally preferred by other users but with prices

CHAPTER 2 LITERATURE REVIEW

Kayak	<ul style="list-style-type: none"> - Provides users with a simple search method to look for the ideal hotel that fits the users' preferences and satisfaction 	<ul style="list-style-type: none"> - The user is limited to only searching for hotel by areas and price range only 	<ul style="list-style-type: none"> - will take him quite an amount of time to go one by one to look for the preferable hotel when the user has strong concept on what kind of hotel he wants
TripAdvisor	<ul style="list-style-type: none"> - Users can search for hotels or homestays that they like using keywords. - Have several filters that allow users to sort the results after searching with the data entered by the users. 	<ul style="list-style-type: none"> - Synonym problem. Which is when the meaning of the words is similar, the system identified as the same category and incorrectly displayed in the result 	<ul style="list-style-type: none"> - Will make the user difficult to find the hotel they want.

CHAPTER 3

System Methodology

3.1 System Development Models

Waterfall, Spiral, and Agile are three unique techniques that serve as compass points in the field of software and system development. The Spiral model encourages iteration and risk management while the Waterfall model takes a structured, sequential approach. Agile, on the other hand, promotes adaptability and customer focus. In this study, the fundamental concepts behind these techniques are elucidated with the goal of assisting the selection of an appropriate path and the formation of judicious development decisions.

3.1.1 System Development Model 1: Waterfall

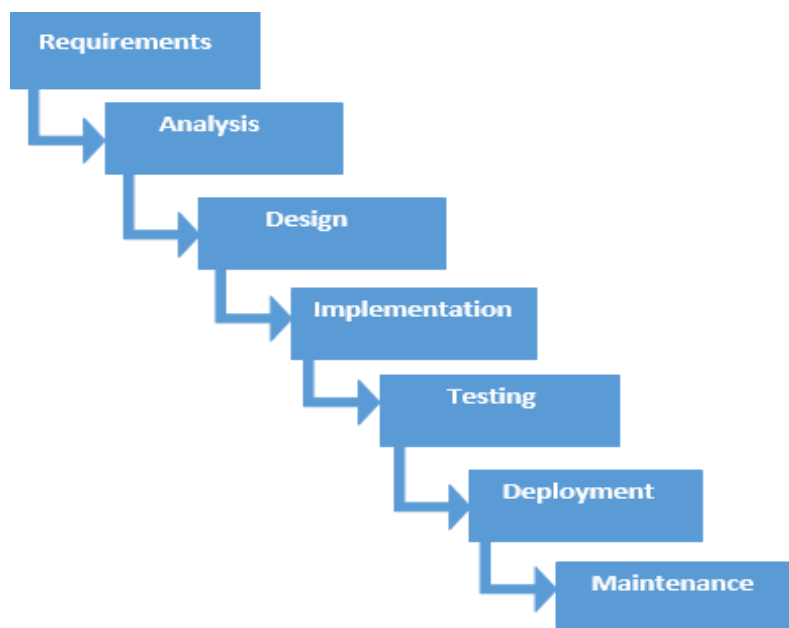


Figure 3.1.1-1: Waterfall System Development Life Cycle (SDLC) Model

The Waterfall model is a linear and sequential approach to SDLC model which often used in large-scale software development projects. In waterfall model, it has to be moving step by step like a waterfall, as this SDLC model requires the completion of one phase before proceeding to the next phase. Each phase is separated, while the outcome of one phase serves as the basis for the next process. [5]Therefore, due to this characteristic, the requirements are well-understood, and the design is well-defined.

CHAPTER 3 SYSTEM METHODOLOGY

The Waterfall Model must complete each phase before the next one can begin, so this SDLC model is usually used when the development team is not expected to have much interaction with end-users because of its structural approach, which is easy to understand.

However, one of the main drawbacks of the Waterfall Model is it is inflexible. Once we complete a phase and begin the next phase, it becomes challenging to make changes to previous phase. Therefore, this SDLC Model is only suitable for large-scale software developments projects.

3.1.2 System Development Model 2: Agile

AGILE SOFTWARE DEVELOPMENT LIFE CYCLE



Figure 3.1.2-1: Agile System Development Life Cycle (SDLC) Model

The Agile Model is a flexible approach to software development methods. In Agile SDLC model, the development process is broken into small iterative cycles called sprint, so that it will get an outcome after each iteration to deliver working software quickly. Each sprint will be fix with a duration of 2-4 weeks for the development team to set a goal and achieve it. [6]

Due to this Agile SDLC model breaking the development process into small iterative cycles which make the developers can make changes easily to ensure that the software meets their needs and requirements. Therefore, the Agile SDLC model is usually used for small or mid-scale software developments projects.

However, one of the main drawbacks for this Agile SDLC model is that the project may end up off track if keep on changing requirements during the process. Therefore, this SDLC Model is only suitable for small or mid-scale software developments projects due to its flexibility and adaptability.

3.1.3 System Development Model 3: Spiral

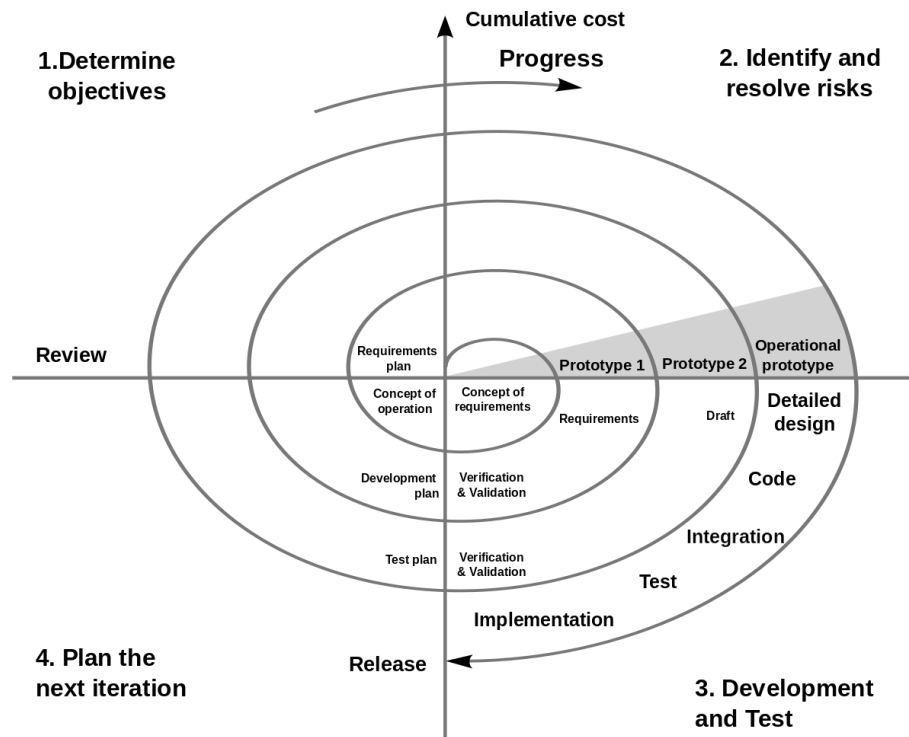


Figure 3.1.3-1: Spiral System Development Life Cycle (SDLC) Model

The Spiral Model is a risk-driven software development model used for risk analysis throughout the development process. It is a flexible model that combines elements of both the Waterfall and the Agile models. In the Spiral SDLC Model, it involves four key stages, which is Determine objectives, Identify and resolve risks, Development and Test and Plan the next iteration. [7]

For this Spiral SDLC Model, it also divides the project into a smaller parts, and focuses on risk management, which means it can help to ensure that the project stays on track before issues become major. Moreover, because it is a model that combine both the Waterfall and the Agile models, Spiral SDLC Model is also flexible, allowing changes to be made to the software development process as the project progresses.

However, one of the main drawbacks for this Spiral SDLC model is that it is time-consuming and expensive, as each cycle of the model involves significant analysis and a huge number of stages. Therefore, this SDLC Model is only suitable for large-scale, expensive, and complicated software developments projects.

3.1.4 Selected Model

After comparing all the System Development Models, which is Waterfall Model, Spiral Model and Agile Model, the selected model will be Agile Model for this project. In this project, the system can be broken into different small iterations, which including getting data, displaying data, and testing each of the small iterations one by one. Furthermore, it allows the system to make changes easily, and if the functional or features is not meet the requirement or need to add new features, the Agile SDLC model will be easier. Last but not least, we can test every iteration after we finish the iteration, so the risk of failures of the system will be decreased.

3.2 System Requirement (Technologies Involved)

3.2.1 Hardware

Figure 3.2-1: Hardware

Description	Specifications
Processor	Intel Pentium G4560
Operating System	Windows 10
Graphic	NVIDIA GeForce GTX 1050 Ti
Memory	16GB RAM
Storage	223GB SATA SSD

3.2.2 Software

Following Table 3.2-1 shows the Software involved in the system.

Table 3.2-1: Software Involved


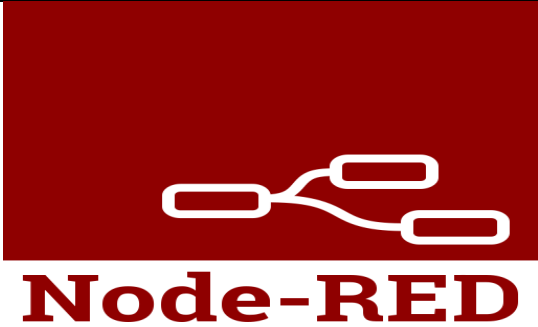

Software	
Node.js	
Node-RED	
Telegram	

Table 3.2-1 shows the software that will be involved in the project. Due to the fact that Node-RED is built on top of Node.js, we have to install Node.js to start the project. After installing Node.js, Node-RED will be the programming tool used to perform web scraping for the project, allowing us to request and receive data. Telegram is used to receive data from Node-RED and display the data to the user when the user wants to see the details.

3.3 Functional Requirement

3.3.1 Web Scraping from current online travel agency (OTA)

This will require the Node-RED library, “node-red-contrib-selenium-webdriver (node),” to help us perform the web scrape from current OTAs. This way, we can request for the necessary data such as Hotel name, Hotel price etc. Moreover, the data must come from few different OTAs such as Agoda, Trivago etc., so that the user can compare the price. The data has to be dynamic and real-time.

3.3.2 User-friendly interface

A user-friendly interface can make it easy for users to compare the hotel prices and enhance convenience. Moreover, it can attract users to use the UI more frequently, leading to higher user satisfaction and enjoyment. Besides, a user-friendly interface can reduce the cognitive load on users which allow them to focus on the things that they want to see or read.

3.3.3 Telegram can perform request and receive data

To further improve user convenience, Telegram Bot is used for the user can request for hotel details by entering the specific command, and the details will be sent to the users. It can make the users more convenience due to the user can check the hotel price or hotel details wherever they are.

CHAPTER 3 SYSTEM METHODOLOGY

3.4 Project Milestone

Following Table 3.4-1 is the project milestone for the development of the system.

Table 3.4-1: Project Milestone for FYP1

Project Task	Project Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Determine System Requirement	■													
Preparing Prototype			■	■	■	■	■	■	■	■	■	■		
Finalize Prototype and Report											■	■		
FYP1 Documentation		■	■	■	■	■	■	■	■	■	■	■		
FYP1 Presentation													■	■
Meeting with Supervisor		■		■		■		■		■		■		

CHAPTER 3 SYSTEM METHODOLOGY

Table 3.4-2: Project Milestone for FYP2

Project Task	Project Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Implement all the necessary function														
Preparing Prototype														
System Testing														
Finalize Prototype and Report														
FYP2 Documentation														
FYP2 Presentation														
Meeting with Supervisor														

3.5 Estimated Cost

Items	For FYP Development	For Commercialization
Node.js	FOC	FOC
Node-RED	FOC	FOC
Telegram	FOC	FOC

Table 3.5-1: Estimated Cost for FYP Development and Commercialization

The estimated cost for this FYP is RM0 is because node.js, Node-RED and Telegram is free open-source programming tools and software.

3.6 Concluding Remark

In summary, this chapter is mainly focus on discussed the system development model that we selected, the system technology involved, functional requirement, expected system testing and performance, expected challenges, project milestone and estimated cost that used during the FYP1 and FYP2.

CHAPTER 4

System Design

4.1 System Architecture

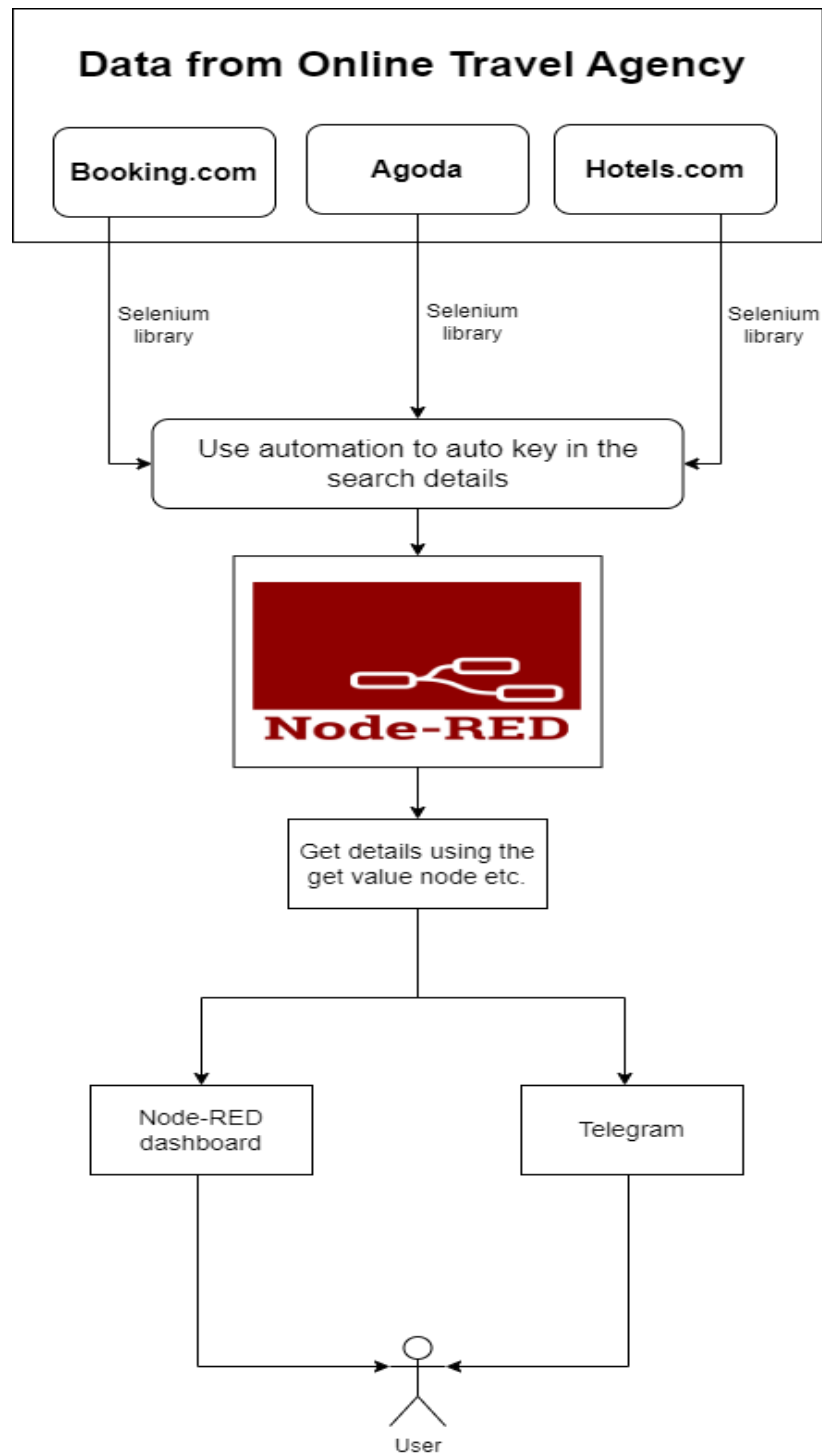


Figure 4.1-1: System Architecture Diagram of the System

CHAPTER 4 SYSTEM DESIGN

In Figure 4.1-1 shown that we use Node-RED library to perform web scrape to request and receive data from the online travel agency (OTA), after the data is collected, it will send to Node-RED. Inside Node-RED the library will start to extract the data that collected from all the online travel agency, such as hotel price, hotel name etc. After that it will display the data to the Node-RED dashboard to let the user can check the details of the hotels.

Moreover, the user also can check the prices on Telegram by entering the specific command to request the data from Node-RED, so that the user do not need to open the Node-RED dashboard frequently for checking, making the Telegram apps a more convenience and time saving option.

4.2 Functional Modules in the System

4.2.1 Automate input data and click on button Module

In this module, its responsibility to assist the user to fill in the input such as Hotel name, hotel booking dates and the number of rooms without requiring manual input. When node-red opens a browser which the link is the main page of Agoda then it will automatically help the user to fill in the predefined value that have been inserted in the node. Afterward, it will navigate to the next page which is the hotel you search.

4.2.2 Web Scrape Data Module

In this module, it is used to web scrape the data from the specific hotels such as the hotel name, hotel price, rating, number of reviewers etc. Node-RED's library contains a node which can locate the specific element and get the text from the element, allowing us to scrape the data form the website.

4.2.3 Dashboard Module

In this module, it will collect the data that scrape from the previous module and show on the dashboard, so that the user can view the data from the Node-RED dashboard UI. There will be a form to let the user to input the places or the hotel name that the user wants to search and then perform all the hotel details in the dashboard.

4.2.4 Telegram Module

In this module, it will send all the hotel details when the user type a command and the system will ask the user to key in the places or hotel name that the user want to search and then send all the hotel details in message form so that the user can view all the hotel details by using the phone instead of need to open the computer.

4.3 System Flow

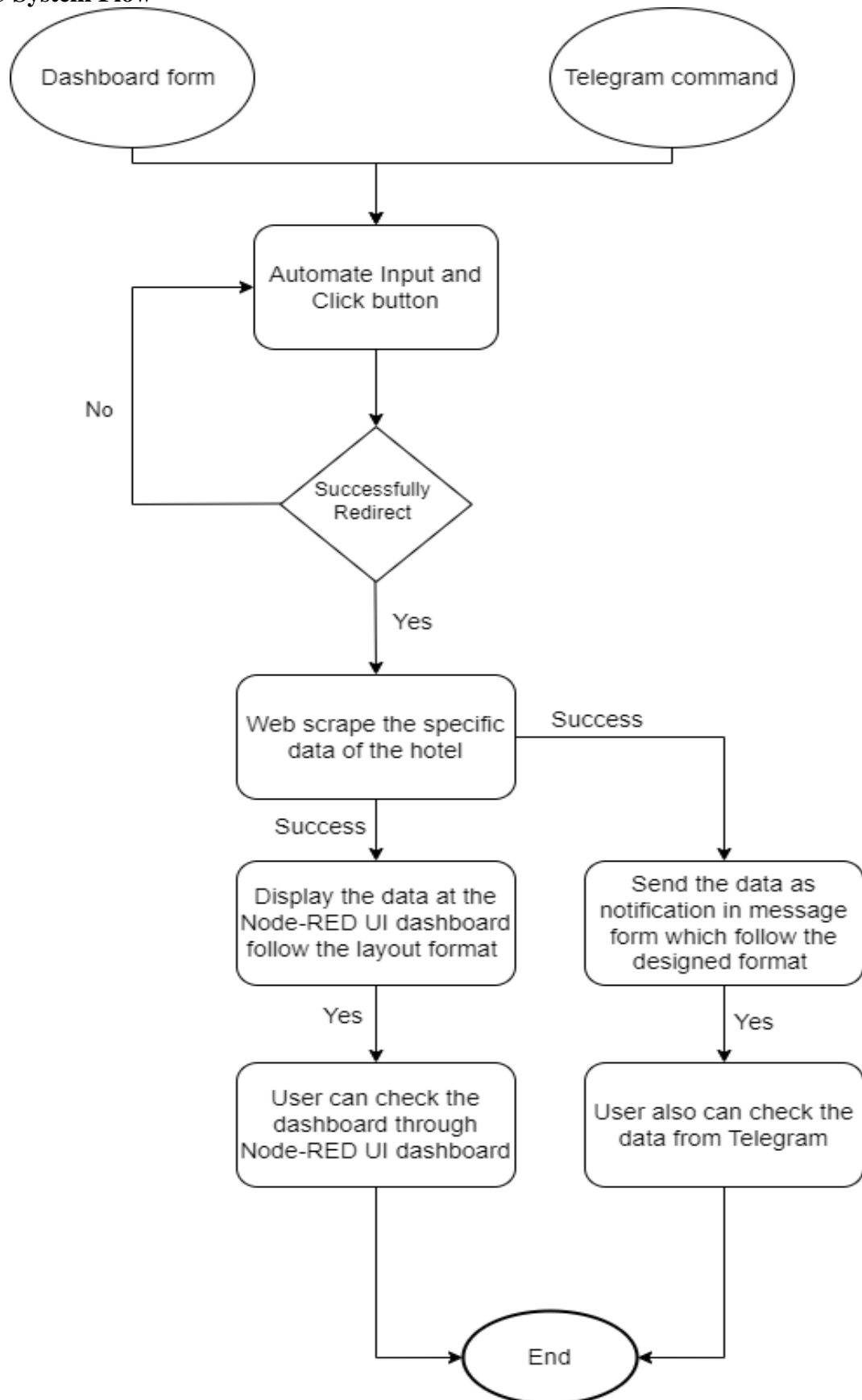


Figure 4.3-1: Flow Cart of the System

CHAPTER 4 SYSTEM DESIGN

When the system starts, it will automate open a browser and put the value that input by the user using the dashboard form. It will also click all the necessary buttons to redirect to the desired webpage. Once the system successfully reaches the website we need, the system will start to web scrape the specific data such as hotel name, hotel prices etc. When all the needed information of the hotel is been web scraped, it will be published on the Node- RED UI dashboard to let the user to view the data.

The user also can use the Telegram command to start the system, and then the system will send a message to ask for places or hotels name that want to search. After a few minutes, the user can view the data from Telegram, so that it can improve the user convenience.

4.4 GUI Design

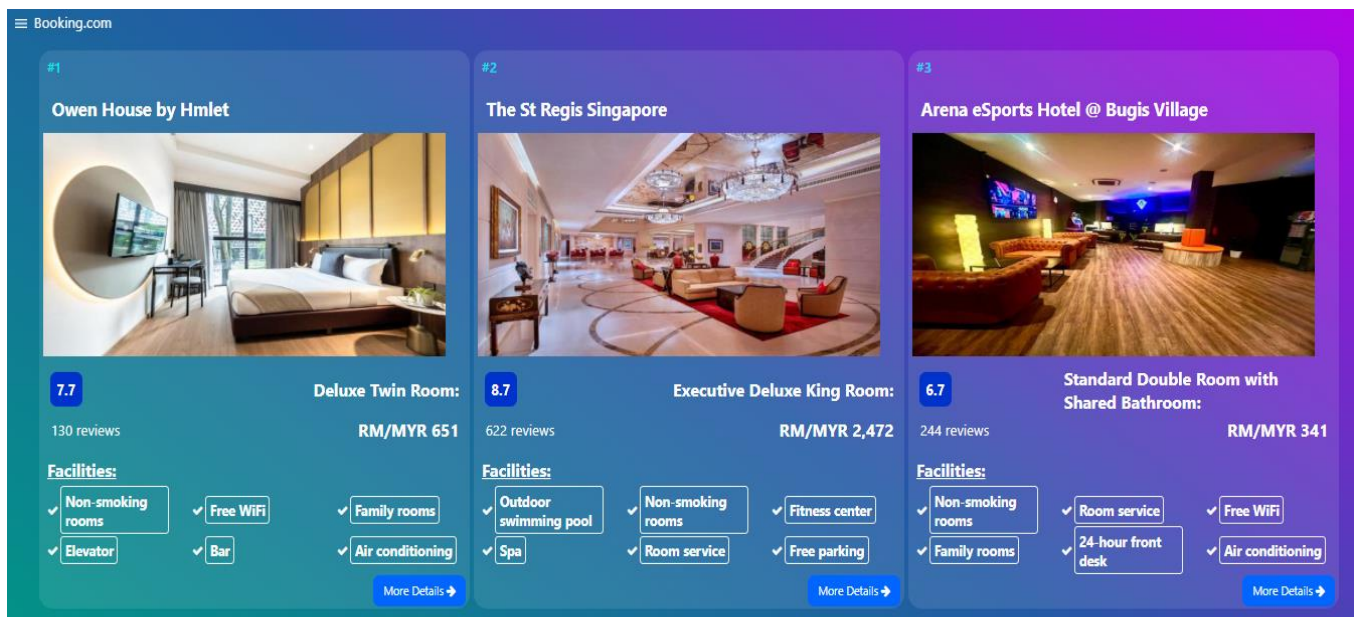


Figure 4.4-1: GUI Design

The picture shown above is the Node-RED dashboard UI. It displays 3 different OTAs, each listing three different hotels, allowing the user to easily compare the prices. Furthermore, it provides information such as the hotel name, room type, prices, rating, number of reviewers and facilities. For more detailed information or if a user wishes to book a hotel, they can simply click the 'More Details' button, which will redirect them to the respective hotel's webpage.

4.5 Concluding Remark

In summary, this chapter is mainly focus on the system design which consist of system architecture diagram which show how the system is linked together, the functional modules of the system which is all the function module of the system, the system design which is how the system flows and all the main steps in the system and the last one the GUI design which shows the UI design that present the data to the user.

CHAPTER 5

System Implementation

5.1 Software Setup

5.1.1 Node.js

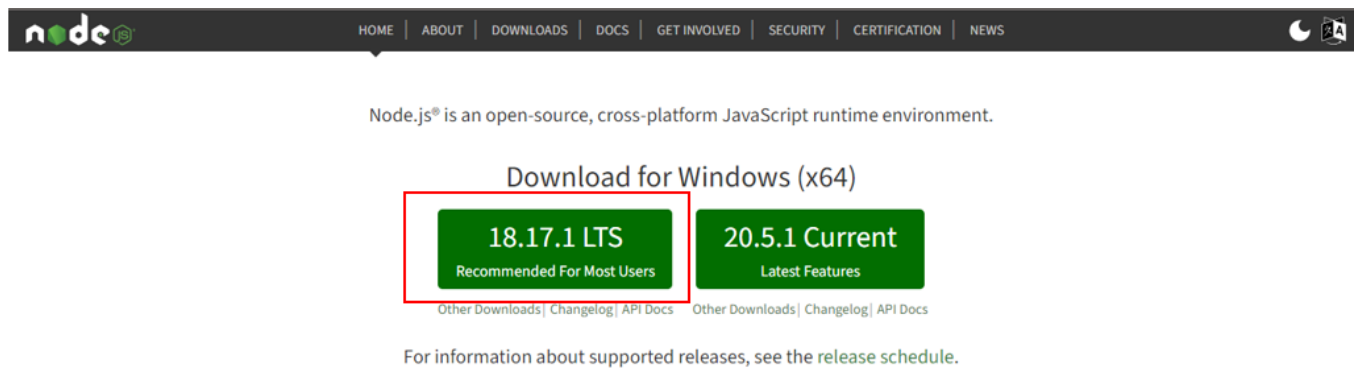


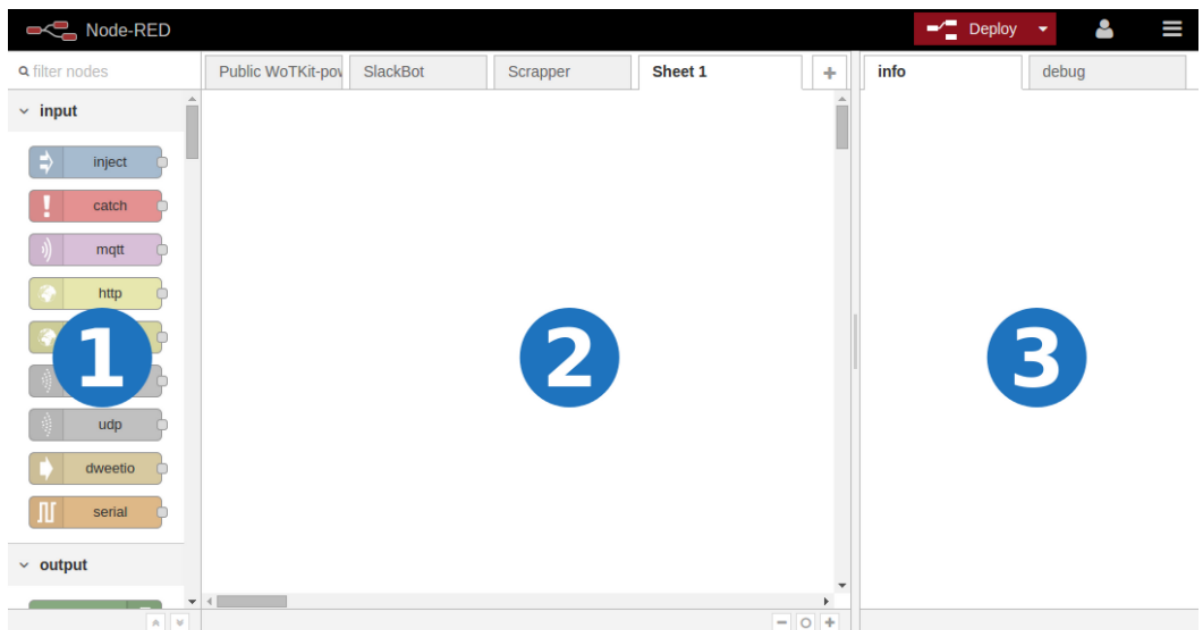
Figure 5.1.1-1: Node.js download page

Node.js is an open source, cross-platform that allows developers to perform server-side JavaScript development. First of all, we need to go to <https://nodejs.org/en/> and choose the **Recommended For Most Users** version like shown in the Figure 5.1.1-1 to download it.

5.1.2 Node-RED

After downloaded and the installation, we can move on to the Node-RED installation. Node-RED is a programming tool that provides a simple drag-and drop interface which allows users to create flows by wiring the nodes together. To allow the user to use the Node-RED , follow the following steps:

- 1) Open a new command prompt and type
`- node --version && npm --version`
- 2) Make sure can see the version of node and npm and then type to install Node-RED.
`- npm install -g --unsafe-perm node-red`
- 3) After the installation, type **node-red** to run the Node-RED tool. Open a browser and connect to Node-RED tool. Type
`- http://127.0.0.1:1880/ or localhost:1880`



1. Node Panel
2. Sheets Panel
3. Info and Debug Panel.

Figure 5.1.2-1: Node-RED Main Page

5.1.3 ChromeDriver

ChromeDriver is a standalone server which provided by the Chromium project that allows software developers and testers to interact with the Google Chrome web browser to perform web automation and web testing. Since we have to perform web scraping using Node-RED, ChromeDriver is a must to install when we want to use the library inside Node-RED. Following are the steps to install and use:

- 1) Open a new command prompt and type
- npm install -g chromedriver
- 2) After the installation, type **chromedriver start** to run the ChromeDriver.

5.1.4 Telegram

To allow the Node-RED to send notification to Telegram, mobile devices need to download the Telegram mobile application, so that Node-RED can send the hotel details to the Telegram.

5.2 Setting and Configuration

5.2.1 Node-RED Library

If we want to start to set up the system, the first thing is we need to prepare all the library that we going to use during the development. First of all, click the setting on the top right corner as shown in Figure 5.2.1-1. Then go to Manage palette > install tab then we can search the library we need to install.

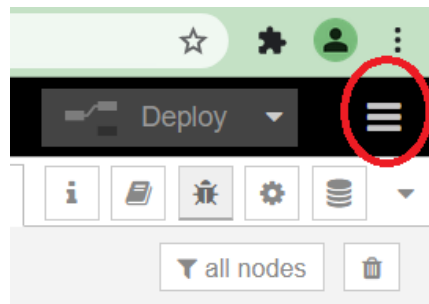


Figure 5.2.1-1: Setting icon

Below are the libraries we need to use and install:

- 1) node-red-contrib-image-tools
- 2) node-red-contrib-simple-webdriver
- 3) node-red-contrib-telegrambot
- 4) node-red-dashboard
- 5) node-red-node-ui-table

For the node-red-contrib-simple webdriver it is used to automation perform web scraping, therefore we have to make sure that the website without any ReCAPTCHA or bot detection otherwise it cannot web scrape anything.

5.2.2 Telegram Bot

Telegram Bot allow the system to send the hotel details to the user, so to create a Telegram Bot we need to open our Telegram application and search “@botfather” as shown in Figure 5.2.2-1.

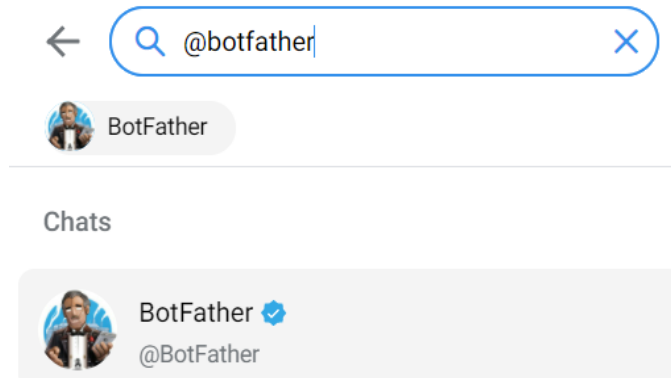


Figure 5.2.2-1: Search “@botfather” in Telegram

Press “/help” for the command menu, then type “/newbot” to add a new bot. After that it will ask you to put the name and username for the bot. Then if successfully created, it will send a message as shown in Figure 5.2.2-2 which contain the token and the Telegram bot link.

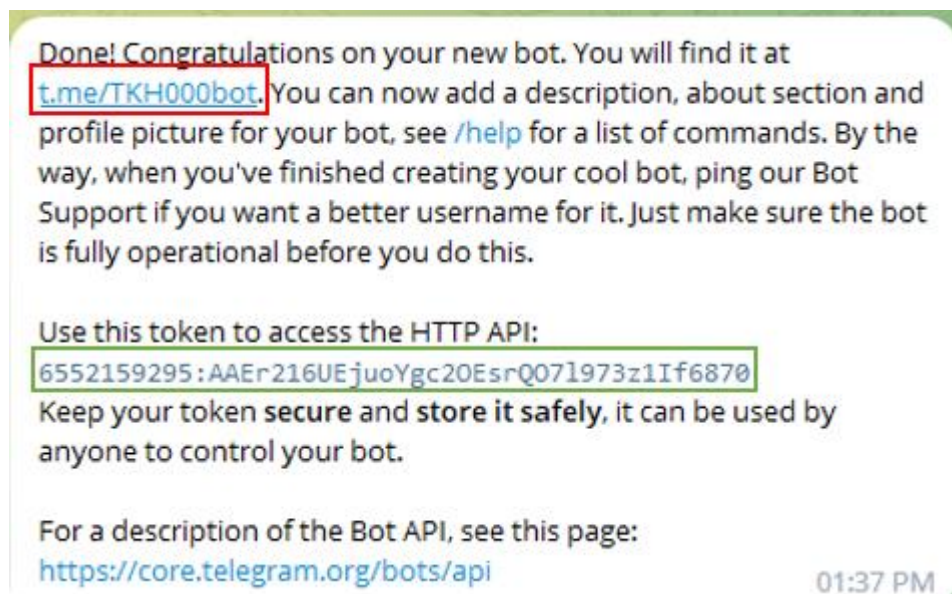


Figure 5.2.2-2: Token and the Telegram bot link

5.2.3 Node-RED JavaScript Code

In figure 5.2.3-1 and figure 5.2.3-2 is the JavaScript code that need to be use for the form submission and telegram when user send input to the system which used to change the output from msg.payload.content to a global variable to ensure that the system processing time to be shorten

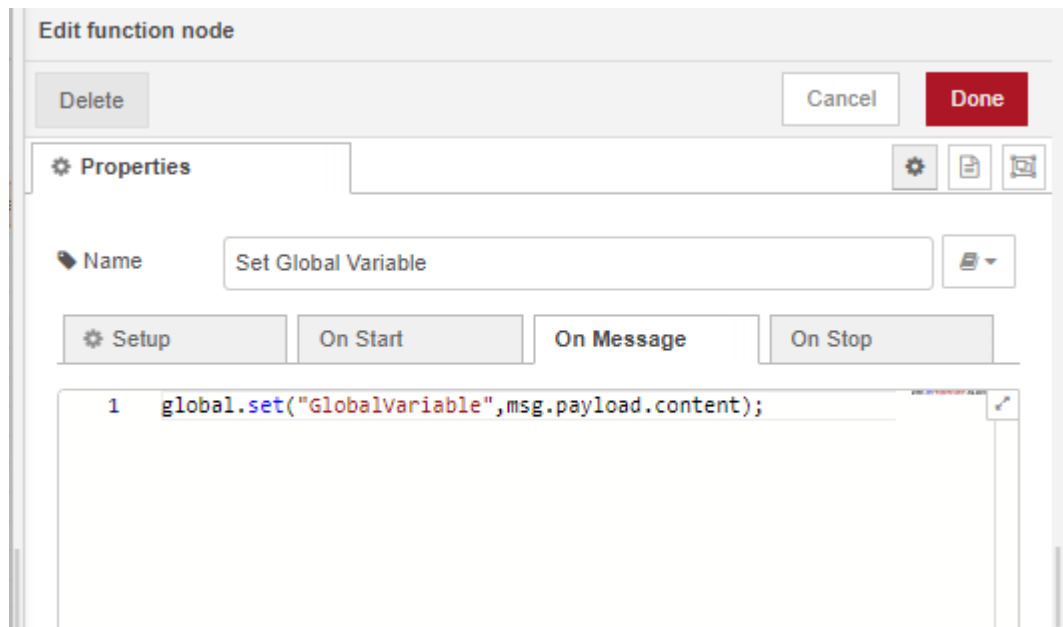


Figure 5.2.3-1: Set Global Variable

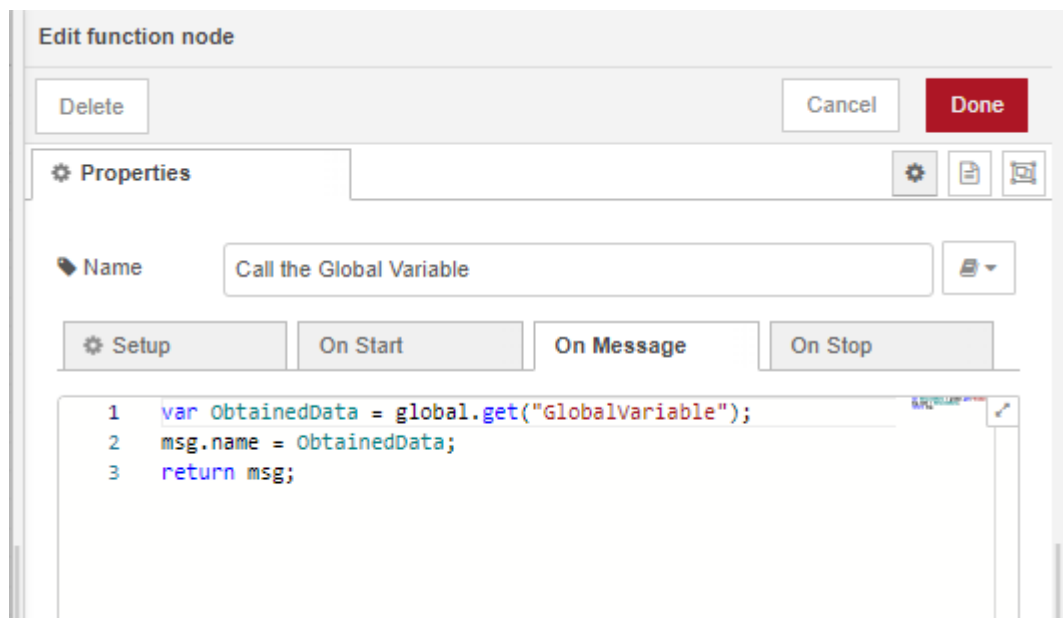


Figure 5.2.3-2: Call Global Variable

```

1  msg.data = msg.payload;
2
3  msg.payload = {
4    chatId: "5852724440",
5    type: "message",
6    content:
7      "Booking.com's Hotel #1" + "\n"
8      + "Hotel Name: " + msg.data[0][1] + "\n"
9      + "Hotel Facilities: \n" + "- " + msg.data[0][5][0]
10     + "\n" + "- " + msg.data[0][5][1]
11     + "\n" + "- " + msg.data[0][5][2]
12     + "\n" + "- " + msg.data[0][5][3]
13     + "\n" + "- " + msg.data[0][5][4]
14     + "\n" + "- " + msg.data[0][5][5] + "\n"
15     + "Hotel Rating: " + msg.data[0][3] + "/10.0" + "\n"
16     + "Number of Reviewers: " + msg.data[0][4] + "\n"
17     + "Hotel Price: " + msg.data[0][2] + "\n\n"
18     + "More details or Book Now: <a href='" + msg.data[0][0][0] + "'>Click here for more details</a>" + "\n\n"
19     + "Booking.com's Hotel #2" + "\n"
20     + "Hotel Name: " + msg.data[1][0] + "\n"
21     + "Hotel Facilities: \n" + "- " + msg.data[1][4][0]
22     + "\n" + "- " + msg.data[1][4][1]
23     + "\n" + "- " + msg.data[1][4][2]
24     + "\n" + "- " + msg.data[1][4][3]
25     + "\n" + "- " + msg.data[1][4][4]
26     + "\n" + "- " + msg.data[1][4][5] + "\n"
27     + "Hotel Rating: " + msg.data[1][2] + "/10.0" + "\n"
28     + "Number of Reviewers: " + msg.data[1][3] + "\n"
29     + "Hotel Price: " + msg.data[1][1] + "\n\n"
30     + "More details or Book Now: <a href='" + msg.data[0][0][1] + "'>Click here for more details</a>" + "\n\n"
31     + "Booking.com's Hotel #3" + "\n"
32     + "Hotel Name: " + msg.data[2][0] + "\n"
33     + "Hotel Facilities: \n" + "- " + msg.data[2][4][0]
34     + "\n" + "- " + msg.data[2][4][1]
35     + "\n" + "- " + msg.data[2][4][2]
36     + "\n" + "- " + msg.data[2][4][3]
37     + "\n" + "- " + msg.data[2][4][4]
38     + "\n" + "- " + msg.data[2][4][5] + "\n"
39     + "Hotel Rating: " + msg.data[2][2] + "/10.0" + "\n"
40     + "Number of Reviewers: " + msg.data[2][3] + "\n"
41     + "Hotel Price: " + msg.data[2][1] + "\n\n"
42     + "More details or Book Now: <a href='" + msg.data[0][0][2] + "'>Click here for more details</a>" + "\n\n"
43   }
44
45   msg.payload.options = { parse_mode: "HTML" };
46   return msg;

```

Figure 5.2.3-3: Telegram Function

In figure 5.2.3-3 is the telegram function that need to be configure before wiring to the telegram sender node. For the chatId, type and content is a must if want to use the Telegram Sender node, chatId can be easily obtain by following the flow shown in figure 5.2.3-4 and then Double click the Telegram receiver, add a new Bot and put the token. Then Deploy. From your telegram, send a “Hello” message to your bot. In your Debug Panel, you should be able to see something like this, {"chatId":1234567890,"messageId":185,"type":"message","content":"hello","date":1626160361}.

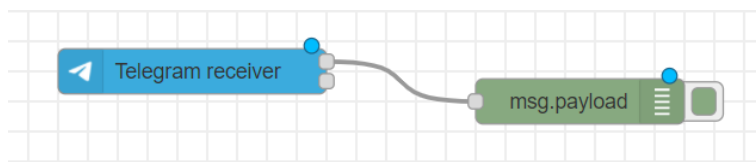


Figure 5.2.3-4: Telegram Flow to retrieve the chatId

After that the content can set whatever u like such as in figure 5.2.3-3 and the msg.payload.options is used to mention the parse_mode which have two mode which is Markdown and HTML.

5.2.4 Node-RED dashboard

To use the Node-RED dashboard we have to type `http://127.0.0.1:1880/ui` or `localhost:1880/ui`. In Figure 5.2.4-1, there will be a group that we have to set up by pressing the dropdown button to add a new dashboard group. After that in the Tab, we have to press the add new dashboard tab to create a new dashboard tab as shown in Figure 5.2.4-2. Lastly, in Figure 5.2.4-3 show the setting of add new dashboard tab that can put the name the user want to set.

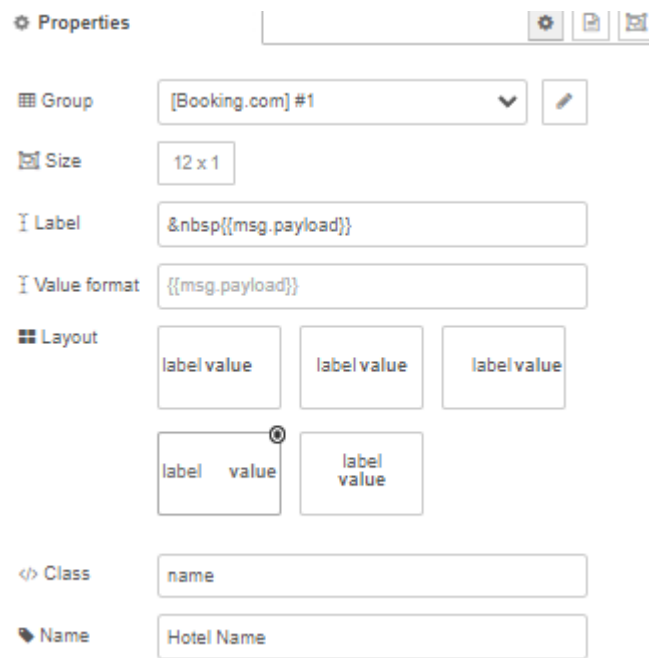


Figure 5.2.4-1: Setting of text dashboard node

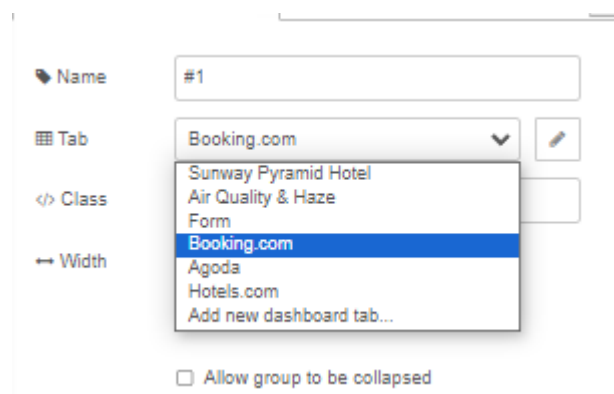


Figure 5.2.4-2: Setting of add a new dashboard group

Edit text node > Edit dashboard group node > Edit dashboard tab node

Delete Cancel Update

Properties

Name Booking.com

Icon dashboard

State Enabled

Nav. Menu Visible

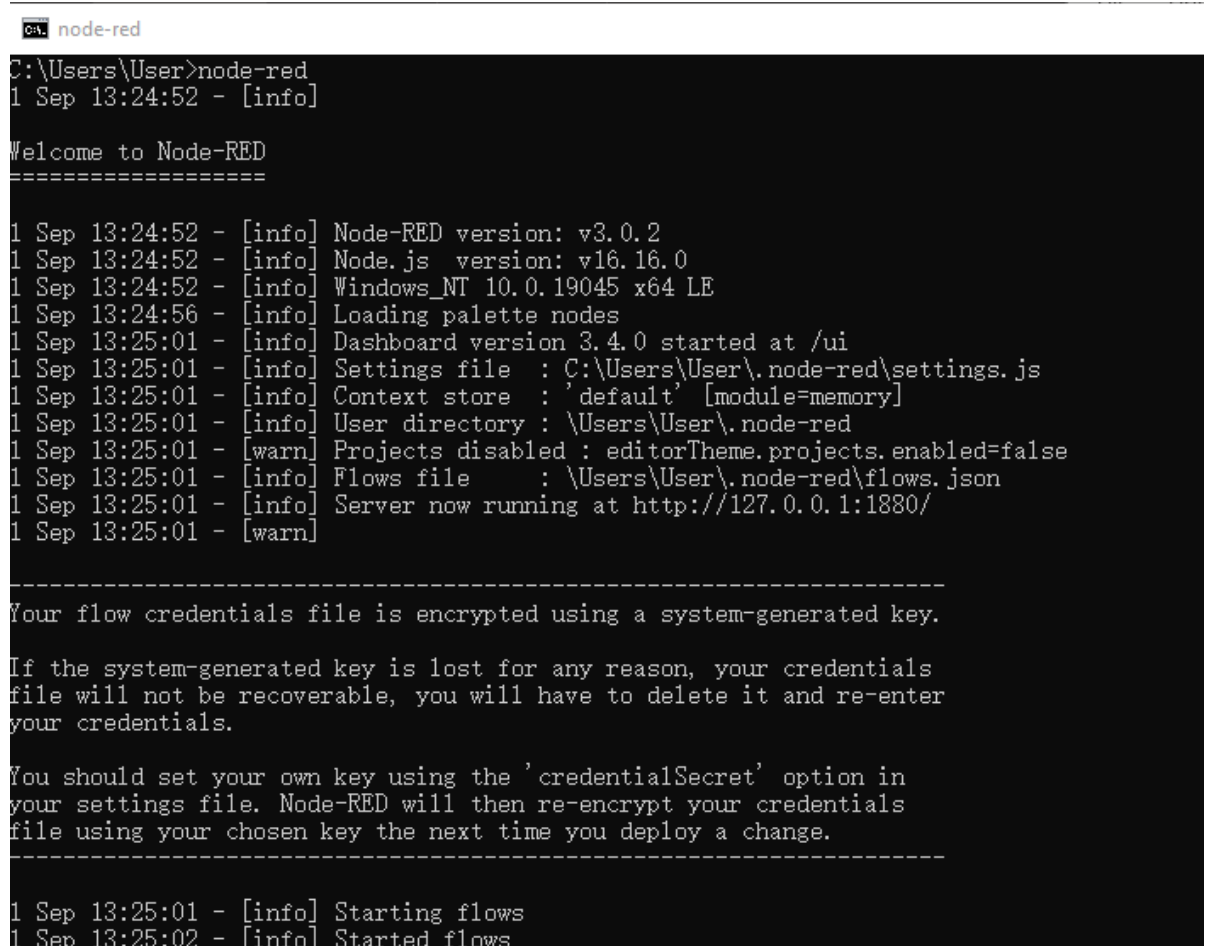
The icon field can be either a [Material Design icon](#) (e.g. 'check', 'close') or a [Font Awesome icon](#) (e.g. 'fa-fire'), or a [Weather icon](#) (e.g. 'wi-wu-sunny').

You can use the full set of google material icons if you add 'mi-' to the icon name. e.g. 'mi-videogame_asset'.

Figure 5.2.4-3: Setting of add a new dashboard tab

5.3 System Operation

To run the system, first step is we have open two command prompt as shown in Figure 5.3-1 and figure 5.3-2 to make sure that the Node-RED is start by typing “node-red” and ChromeDriver is start by typing “chromedriver start”. In figure 5.3-3 shown that the nodes that need to be used to perform automation during the user input which use Booking.com as example:



```

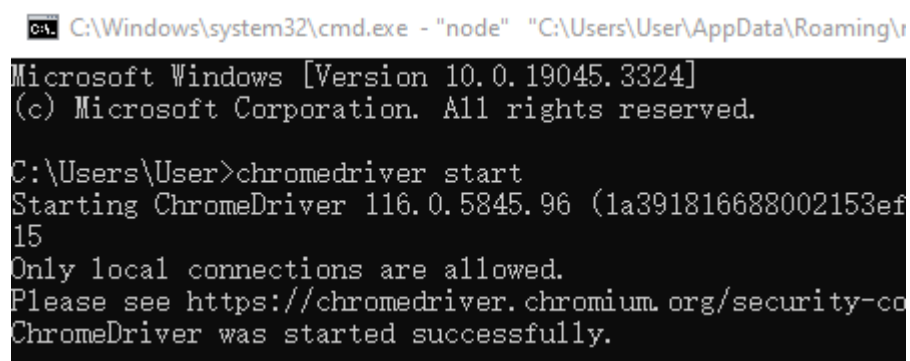
node-red
C:\Users\User>node-red
1 Sep 13:24:52 - [info]
Welcome to Node-RED
=====
1 Sep 13:24:52 - [info] Node-RED version: v3.0.2
1 Sep 13:24:52 - [info] Node.js version: v16.16.0
1 Sep 13:24:52 - [info] Windows_NT 10.0.19045 x64 LE
1 Sep 13:24:56 - [info] Loading palette nodes
1 Sep 13:25:01 - [info] Dashboard version 3.4.0 started at /ui
1 Sep 13:25:01 - [info] Settings file : C:\Users\User\.node-red\settings.js
1 Sep 13:25:01 - [info] Context store : 'default' [module=memory]
1 Sep 13:25:01 - [info] User directory : \Users\User\.node-red
1 Sep 13:25:01 - [warn] Projects disabled : editorTheme.projects.enabled=false
1 Sep 13:25:01 - [info] Flows file : \Users\User\.node-red\flows.json
1 Sep 13:25:01 - [info] Server now running at http://127.0.0.1:1880/
1 Sep 13:25:01 - [warn]
-----
Your flow credentials file is encrypted using a system-generated key.

If the system-generated key is lost for any reason, your credentials
file will not be recoverable, you will have to delete it and re-enter
your credentials.

You should set your own key using the 'credentialSecret' option in
your settings file. Node-RED will then re-encrypt your credentials
file using your chosen key the next time you deploy a change.
-----
1 Sep 13:25:01 - [info] Starting flows
1 Sep 13:25:02 - [info] Started flows

```

Figure 5.3-1: Node-RED terminal



```

C:\Windows\system32\cmd.exe - "node" "C:\Users\User\AppData\Roaming\
Microsoft Windows [Version 10.0.19045.3324]
(c) Microsoft Corporation. All rights reserved.

C:\Users\User>chromedriver start
Starting ChromeDriver 116.0.5845.96 (1a391816688002153ef
15
Only local connections are allowed.
Please see https://chromedriver.chromium.org/security-co
ChromeDriver was started successfully.

```

Figure 5.3-2: ChromeDriver terminal



Figure 5.3-3: Flow for automation which use booking.com as example

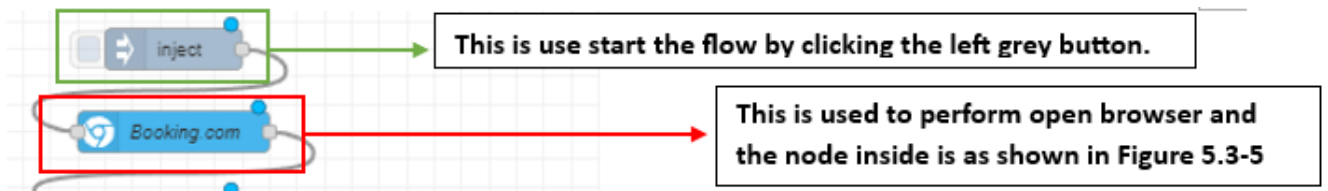


Figure 5.3-4: Inject and open browser node

In figure 5.3-4 shown that the used of the node for the inject node is used to start the flow by clicking the grey button which is at the left side of the node and for the red column the blue node is the open browser node which used to perform open browser with the pre-set link inside the node. The node inside is shown in Figure 5.3-5.

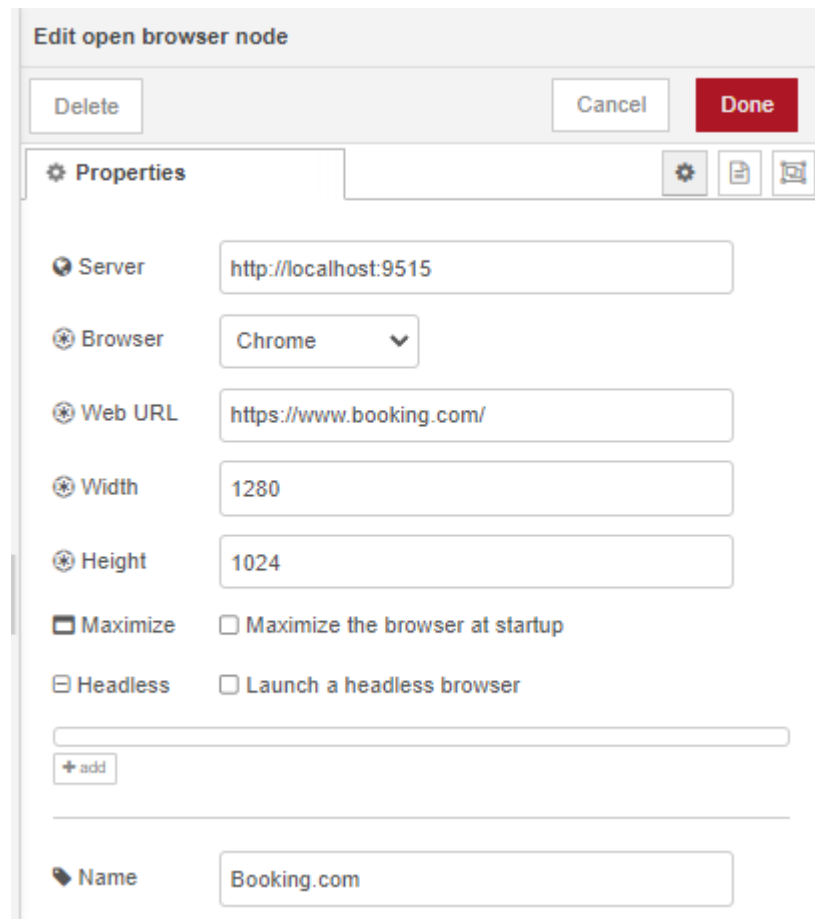


Figure 5.3-5: Setting of open browser node

In Figure 5.3-5, the user can set the link we want to perform automation at the Web URL and other details for the open browser node. In Figure 5.3-6 is show that the node that need to be used to create a flow that can automate to key in user input and in Figure 5.3-6 is using Booking.com as example, if using other webpage there will be different since the html design and the webpage design is different for each webpage, so the flow also will be different.

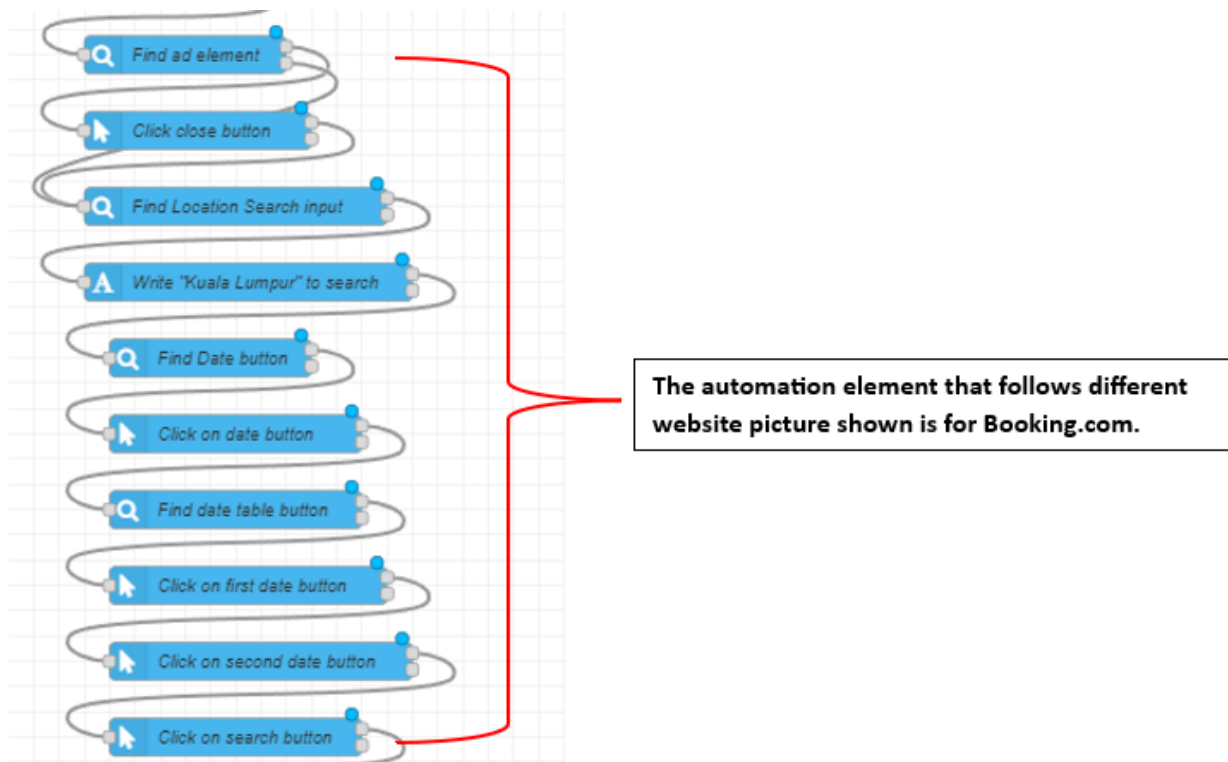


Figure 5.3-6: All the automation node needed for Booking.com

In Figure 5.3-7 shown the node can be targeted by using the id, name, link, xpath, tagName, className, linkText and cssSelector this eight elements to target what user want to web scrape. Therefore, we have to design a logic and suitable node and then wiring all together to become a flow that suitable for the targeted website.

Figure 5.3-7: Setting of Click on node

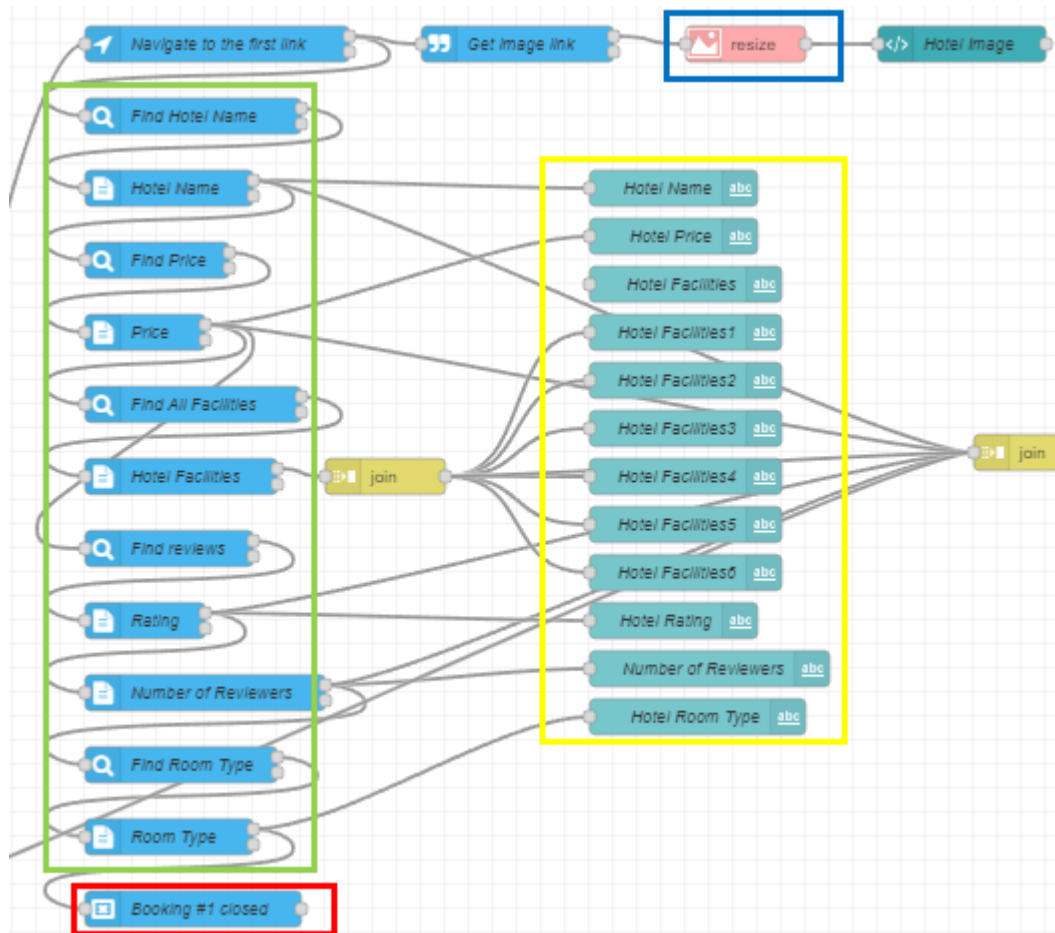


Figure 5.3-8: Flow for Web scraping

In Figure 5.3-8 shows the web scraping flow and also the dashboard flow that used to display the data to the Node-RED dashboard UI. First, for the green box is the nodes that used to web scrape the data and the settings is similar like Figure 5.3-7. For the red box is the node to close the browser to reduce the resources. For the blue box which contain the node from the node-red-contrib-image-tools library that is used to process the image link that scrape from the targeted website that used to decorate the Node-RED dashboard UI by wiring to the ui template node. For the yellow box is the nodes from the node-red-dashboard that used for the Node-RED dashboard UI.

CHAPTER 5 SYSTEM IMPLEMENTATION

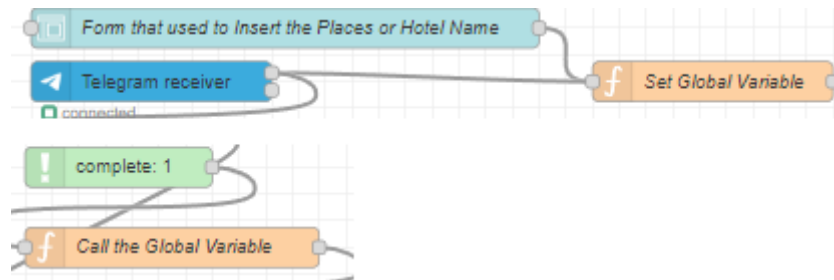


Figure 5.3-9: Form node and Telegram receiver node

In Figure 5.3-9 is the two node that used to let user to input the places that want to search for and the set the data into global variables and call when complete. In Figure 5.3-10, “/start” will ask a question, when user type a valid places or hotel name then a reply message will send to the user. After the system done processing the hotel details will be send to the user.

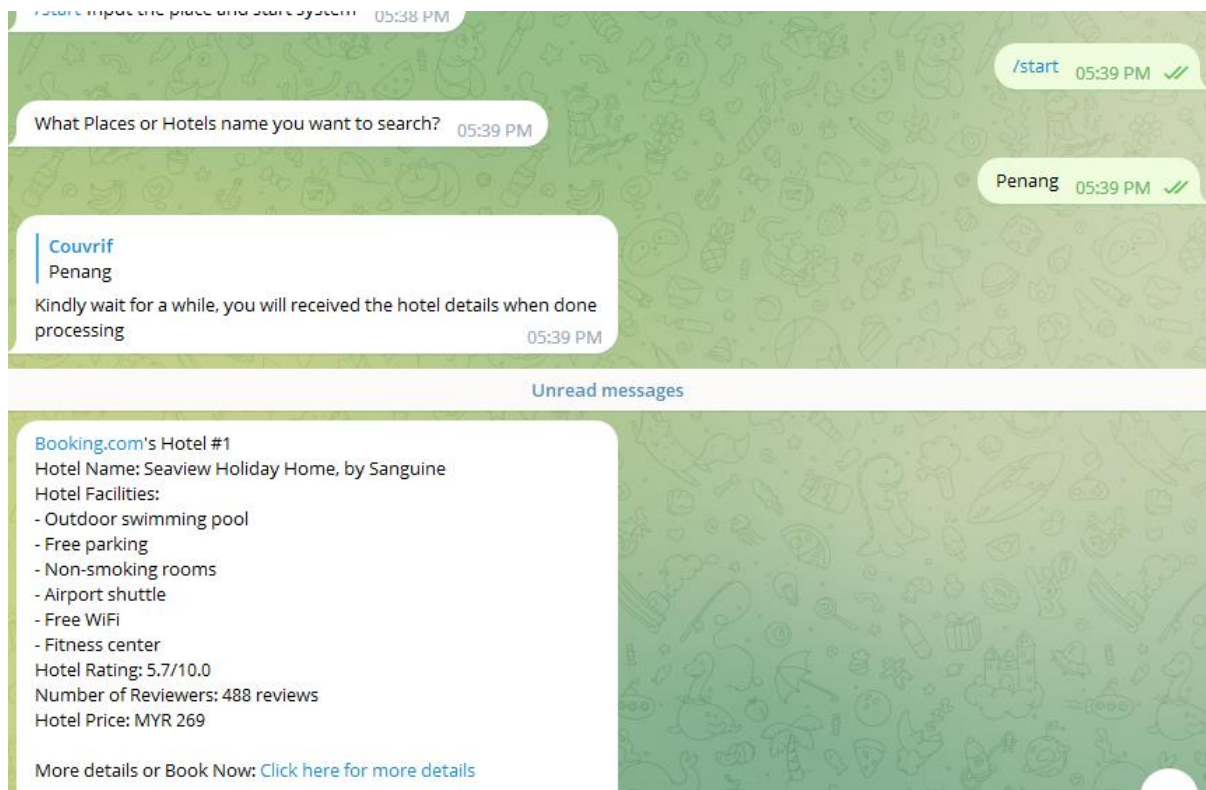


Figure 5.3-10: Telegram message when receive a command

All the data will be uploaded to the Node-RED dashboard as shown in Figure 5.3-11.

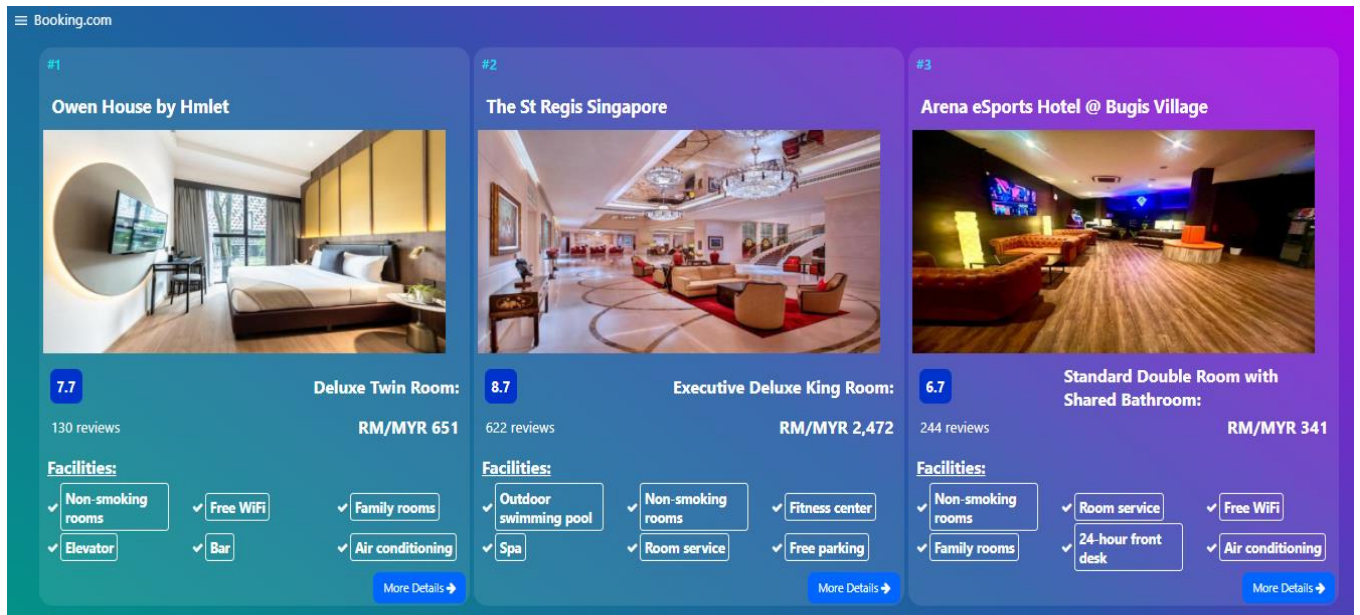


Figure 5.3-11: Node-RED dashboard

5.4 Concluding Remark

In this chapter, the setup of the software that needed in the system is explained. The setting and configuration that needed for the system is explained and shown step by step with the screenshot. Last but not least, the system operation also explained in a very detail way in this chapter.

CHAPTER 6

System Evaluation and Discussion

6.1 System Testing and Performance Metrics

In the system testing, there will be two types of testing will be conducted which is the accuracy testing and connectivity testing. For the accuracy testing, there will be two types of tests. Firstly, is the Data Accuracy Testing, after the user submits the form in the Node-RED UI dashboard or triggers the system from Telegram, the accuracy of the web scraped data from the targeted three OTAs will be examined to ensure the data is up to date. The second type of accuracy testing is the Flow Success Rate Testing. In this testing, the focus will be on accessing the success rate of the entire flow initiated by the user no matter is Node-RED UI dashboard or Telegram.

For the connectivity testing, it will be testing two types of testing which is the Node-RED to Node-RED UI dashboard and Node-RED to Telegram. The first type of testing which is the Node-RED to Node-RED UI dashboard connectivity testing is to examine whether the data that web scraped from all the targeted OTAs is uploaded and displayed properly into the Node-RED UI dashboard. Other than that, the connectivity testing for Node-RED to Telegram, this testing is to make sure that the notifications that send to the Telegram is sent successfully as follow the pre-set format and is it sent successfully.

6.2 Testing Setup and Result

6.2.1 Accuracy Testing for success rate of the entire flow

For the success rate of the entire flow have been separated into two parts which is form submission to trigger and Telegram trigger. Table 6.2.1-1 is the testing result:

Table 6.2.1-1: Testing Result using Form and Telegram.

Test Case (F-Form) (T-Telegram)	Automation flow of Booking.com	Web scrape flow of Booking.com	Automati on flow of Agoda	Web scrape flow of Agoda	Automatio n flow of Hotels.com	Web scrape flow of Hotels.com	Success
F-1	✓	✓	✓	✓	✓	✓	✓
F-2	✓	✓	✗	✓	✓	✓	✗
F-3	✓	✓	✓	✓	✓	✓	✓
F-4	✓	✓	✓	✓	✗	✓	✗
F-5	✓	✓	✓	✓	✓	✓	✓
F-6	✓	✓	✓	✓	✓	✓	✓
F-7	✓	✓	✗	✓	✓	✓	✗
F-8	✓	✓	✓	✓	✓	✓	✓
F-9	✓	✓	✓	✓	✓	✓	✓
F-10	✗	✓	✓	✓	✓	✓	✗
T-1	✓	✓	✓	✓	✓	✓	✓
T-2	✓	✓	✓	✓	✓	✓	✓
T-3	✓	✓	✓	✓	✓	✓	✓
T-4	✓	✓	✗	✓	✓	✓	✗
T-5	✓	✓	✓	✓	✓	✓	✓
T-6	✓	✓	✓	✓	✓	✓	✓
T-7	✗	✓	✓	✓	✓	✓	✗
T-8	✓	✓	✓	✓	✓	✓	✓
T-9	✓	✓	✓	✓	✓	✓	✓
T-10	✓	✓	✓	✓	✓	✓	✓
Number of success rate							14/20
Percentage of Accuracy							70%

CHAPTER 6 SYSTEM EVALUATION AND DISCUSSION

From Table 6.2.1-1, we can see that most of the time is the automation that affect the success rate. This is mainly due to the date picker in every targeted OTA. The node that used to target the date picker cannot always locate accurately no matter is which element out of the eight elements that provided by the node. This issue results in the success rate testing result doesn't meet 100.

In this testing, we can know that the date picker causes the success rate to become low due to the node cannot locate accurately the targeted element which cause the inconsistency of the system's performance but for the web scraping node can achieve 100% success rate. This indicates that if the system passes the automation phase it works fine.

6.2.2 Accuracy Testing for data accuracy

For this testing is to validate the hotel details that web scraped from all the selected OTA that is up to date and is accurate. Since the hotels is in dynamic which means the user send the places to the system the hotels that show is different therefore the data must be accurate. Table 6.2.2-1 is the testing result:

Table 6.2.2-1: Data accuracy testing result

Test Case (F-Form) (T-Telegram)	Data Accuracy of Booking.com	Data Accuracy of Agoda	Data Accuracy of Hotels.com	Result that compares with the respective OTA	Success
F-1	✓	✓	✓	100% Accurate	✓
F-2	✓	✓	✓	100% Accurate	✓
F-3	✓	✓	✓	100% Accurate	✓
F-4	✓	✓	✓	100% Accurate	✓
F-5	✓	✓	✓	100% Accurate	✓
F-6	✓	✓	✓	100% Accurate	✓
F-7	✓	✓	✓	100% Accurate	✓
F-8	✓	✓	✓	100% Accurate	✓
F-9	✓	✓	✓	100% Accurate	✓
F-10	✓	✓	✓	100% Accurate	✓
T-1	✓	✓	✓	100% Accurate	✓
T-2	✓	✓	✓	100% Accurate	✓
T-3	✓	✓	✓	100% Accurate	✓
T-4	✓	✓	✓	100% Accurate	✓
T-5	✓	✓	✓	100% Accurate	✓
T-6	✓	✓	✓	100% Accurate	✓
T-7	✓	✓	✓	100% Accurate	✓
T-8	✓	✓	✓	100% Accurate	✓
T-9	✓	✓	✓	100% Accurate	✓
T-10	✓	✓	✓	100% Accurate	✓
Number of accurate test cases					20/20
Percentage of Accuracy					100%

CHAPTER 6 SYSTEM EVALUATION AND DISCUSSION

Based on Table 6.2.2-1, there are 100% accuracy out of 20 test cases. This indicates that, once we successfully passed the automation phase and properly configured the elements, the system will have a 100% accuracy for all the targeted data. However, for some situation there will be also some error happened when the element is not set properly set or when the element such as className that will make the node confused, as they are commonly used and may be similar. Therefore, with proper configuration then it shouldn't be error occur and the user can web scrape the data needed.

In this accuracy testing, we can see that the data the web scraped by Node-RED library is accurate if all the element is properly configured.

6.2.3 Connectivity and Accuracy Testing for Node-RED to Node-RED UI dashboard

Node-RED dashboard is a UI page that let user to do form submission and display the data send from the Node-RED, so that the user can monitor and read the hotel details. In this testing, we need to make sure that every time the user run the system the data can properly show at the Node-RED UI dashboard immediately no matter the user run the system how many times. Moreover, the data that display in the Node-RED UI dashboard is accurate.

Therefore, we have gone through 10 times of testing to test that can the data display at the Node-RED UI dashboard immediately, accurately, and properly which follow the layout. Table 6.2.3-1 shows the result:

Figure 6.2.3-1: Testing result of dashboard display

Test Cases	Display data immediately	Display data accurately	Success
C-1	✓	✓	✓
C-2	✓	✓	✓
C-3	✓	✓	✓
C-4	✓	✓	✓
C-5	✓	✓	✓
C-6	✓	✓	✓
C-7	✓	✓	✓
C-8	✓	✓	✓
C-9	✓	✓	✓
C-10	✓	✓	✓
Number of accurate test cases			10/10
Percentage of Accuracy			100%

In this testing, we can see the accuracy and connectivity between Node-Red and Node-RED UI dashboard is very good. It can display the data accurately and without any delay after the system done processing.

6.2.4 Connectivity and Accuracy Testing for Node-RED to Telegram

Telegram is a social media application that let user to do input the places that want to search and send message in notifications form which the data send from the Node-RED, so that the user can monitor and read the hotel details. In this testing, we need to make sure that every time the user run the system the data can properly send to the user through Telegram immediately no matter the user run the system how many times. Moreover, the data that send to the user through Telegram is accurate and format is follow exactly the pre-set format .

Therefore, we have gone through 10 times of testing to test that can the data send to the user through Telegram immediately, accurately, and properly which follow the format. Table 6.2.4-1 shows the result:

Figure 6.2.4-1: Testing result of Telegram's message received

Test Cases	Send data immediately	Send data accurately	Success
B-1	✓	✓	✓
B-2	✓	✓	✓
B-3	✓	✓	✓
B-4	✓	✓	✓
B-5	✓	✓	✓
B-6	✓	✓	✓
B-7	✓	✓	✓
B-8	✓	✓	✓
B-9	✓	✓	✓
B-10	✓	✓	✓
Number of accurate test cases			10/10
Percentage of Accuracy			100%

In this testing, we can see the accuracy and connectivity between Node-Red and Telegram is very good. It can send the data accurately and send message without any delay after the system done processing.

6.3 Project Challenges

Various challenges that cannot currently be resolved have been encountered with this project. The challenges might cause by the API of the Node-RED library which is the Selenium library and some unavoidable issue such as processing time that may need to wait for further update for the Selenium library.

Challenge 1: Date picker cannot follow the user input.

The Node-RED Selenium library doesn't provide any settings for the user to input specific date they want such as the exact check-in date they desire, Currently, for the node that provided by the Selenium library only can manually set by the user. For an example, if the user wants to check hotel details for 15th August 2023, they must manually go to the OTA webpage, copy the xpath or cssSelector and put it into the node to make the whole system work.

How to overcome: There is no others way to overcome this problem yet.

Challenge 2: Website consists of bot detection cannot perform web scraping.

The Node-RED Selenium library cannot perform web scraping on the website that have bot detection mechanisms. For this project, only three OTA websites can be used for web scraping, as most of the OTAs have implemented bot detection mechanisms. Therefore, it will be a significant challenge for the project that use Node-RED Selenium Library as development tools for monitoring system.

How to overcome: There is no others way to overcome this problem yet.

Challenge 3: The processing time to run the whole system is still slow.

In this project, running the entire system to perform web scraping for nine hotels in one run is almost 3 to 3.5 minutes. This processing time is close to the maximum duration, assuming in a good network environment. This is due to the resources is huge since the flow need to open google chrome to perform the progress of web scraping which cause the user need to wait a couple of times to receive the hotel details.

How to overcome: To overcome this problem, we can design a flow that consider the user's computer capabilities. if the user's computer can handle multiple browsers, then it will reduce the processing time since some delay node will be unnecessary.

6.4 Objectives Evaluation

The project's objectives, which are listed previously in Chapter 1, are listed as follows:

- 1) To allow users to track hotel prices in real-time and scrape it correctly, allowing hotel revenue managers and travelers to make informed decisions based on the most up-to-date pricing information.

This objective is fully achieved since in the previously system testing and result also shown that all the data that web scraped by the Node-RED Selenium Library is up to date and is accurate. Moreover, the Node-RED UI dashboard can display the data immediately and accurately. Furthermore, the users also can receive the message using the Telegram mobile application.

- 2) To develop a system that able to collect pricing data from various sources, such as hotel websites, online travel agencies, and other booking channels, to provide a comprehensive view of the market.

This objective also fully achieved. In the previous testing also shown that we can web scrape different website that doesn't have any bot detection. Although there are two minor shortcoming such as the bot detection and the date picker issues, we are able to collect data from various source.

- 3) To develop a hotel price monitoring system that able to handle large volumes of data and provide fast and reliable performance.

This objective is fully achieved, although the system's performance may not be extremely fast. It successfully processes a large volume of data including information of nine hotels and various details for each of the hotel and provide a reliable performance. From the previous system testing confirmed that the system can accurately web scrape these large volumes of data in a reliable and reasonably fast performance.

6.5 Concluding Remark

This chapter focus on demonstrates the performance analysis and system testing and the testing result of the system. Moreover, this chapter also demonstrates the project's challenges that currently cannot be solved and the objectives evaluation of the project.

CHAPTER 7

Conclusion

7.1 Conclusion

Travel is one of the best ways to relieve work-related stress and have some relax time at the same experience different culture and learn some new things and meet some new perspectives on the world. Shelter, also one of the basic needs of human beings which can provide protection from other dangers especially when we go travel shelter become very important. Therefore, hotel become important to us when go to travel especially due to the pandemic last few years before which make travelers become more and more. There are a lot of OTAs now, that provide most of the hotel details to users. However, the proliferation of travel apps and websites means that users often have to check the hotel details by visiting the OTA apps or website one by one. In this project, we developed the system as Hotel Price Monitoring System which can monitor hotel prices and most of the hotel details which we collect from different OTAs to make the enhance user convenience when checking hotel details.

From the proposed idea, we planned to use the Node-RED's library which can automate open a browser and put the pre-set value and click all the necessary button, so that it will redirect to the page we want, so that we can pass through the homepage. When the system successfully reached the website we need, the system will start to perform web scrape the specific data such as hotel name, hotel price etc. When all the needed information of the hotel is been web scraped then it will publish to the Node-RED UI dashboard to let the user to view the data. Furthermore, the user also can input the places that want to search for by submitting the form in the Node- RED UI dashboard and in Telegram application. Moreover, Telegram also can receive notification which consist of hotel details after typing command.

The system that developed also reach the expectations since the objective that proposed at the beginning of the plan had been achieved. In this project, a performance analysis has been carried out to comprehend the nodes between nodes and the ways of wiring into flow and it able to improve the convenience of the user during trip planning.

7.2 Recommendation

There is some recommendation that can be implemented in this Hotel Price Monitoring System Using Low Code Platform (Node-Red) to improve the system in the future:

- **User can key in the desired date in the form on the Dashboard or in Telegram instead of needing to preset the data manually.** To implement this the Node-RED Selenium library needs to have a setting that can let user to compare the input result and the value of the targeted element.
- **User can also web scrape the website which have bot detection, so that there will be more choices of website.** To implement this the Node-RED Selenium library needs to have a setting that can help the user to bypass or handle the bot detection maybe integrating CAPTCHA-solving mechanisms.
- **Allow user to choose which OTA that the user want to know instead of needing to activate the whole system.** Currently the system cannot choose the specific OTA they want to query for hotel information, if this function is implemented then the system will be more user-centric and efficient.
- **Allow user to process in a much faster processing time since nowadays more and more people want to get things done instantly.** To address this, maybe need to consider parallel processing techniques, so that the system can ensure that users can access hotel details quickly, even during peak usage times.

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Format: websites

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Appendix

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Year 3 Sem 3	Study week no.: 2
Student Name & ID: Tan Kok Han 20ACB06360	
Supervisor: Ts Dr Goh Hock Guan	
Project Title: Development of Hotel Price Monitoring Application Using Low Code Platform	

1. WORK DONE

- Read through the guideline of the report format and presentation.
- Revise the system flow that done from FYP1.
- Do amendment for the report Chapter 1 to Chapter 4 based on the moderator and supervisor comment

2. WORK TO BE DONE

- Automation for the system.

3. PROBLEMS ENCOUNTERED

- Automation for the date picker keep on error.

4. SELF EVALUATION OF THE PROGRESS

- Starting with progress.



Supervisor's signature



Student's signature

Appendix

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Year 3 Sem 3	Study week no.: 4
Student Name & ID: Tan Kok Han 20ACB06360	
Supervisor: Ts Dr Goh Hock Guan	
Project Title: Development of Hotel Price Monitoring Application Using Low Code Platform	

1. WORK DONE

- Done the automation for the Booking.com
- Test the automation

2. WORK TO BE DONE

- Web scrape data from Booking.com

3. PROBLEMS ENCOUNTERED

- Automation for the date picker still very inconsistent even though pre-set the date.

4. SELF EVALUATION OF THE PROGRESS

- The system is tested, but there is still modification which take times to make it done.



Supervisor's signature



Student's signature

Appendix

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Year 3 Sem 3	Study week no.: 6
Student Name & ID: Tan Kok Han 20ACB06360	
Supervisor: Ts Dr Goh Hock Guan	
Project Title: Development of Hotel Price Monitoring Application Using Low Code Platform	

1. WORK DONE

- Done the flow for Booking.com with one hotel.

2. WORK TO BE DONE

- Testing out how to get dynamic hotels instead of one hotel only.

3. PROBLEMS ENCOUNTERED

- Only can get the first hotel result and automation into the webpage, if want the second and third hotel result cannot work.

4. SELF EVALUATION OF THE PROGRESS

- Progress is slow due to there is too much error and trial when testing the system flow.



Supervisor's signature



Student's signature

Appendix

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Year 3 Sem 3	Study week no.: 8
Student Name & ID: Tan Kok Han 20ACB06360	
Supervisor: Ts Dr Goh Hock Guan	
Project Title: Development of Hotel Price Monitoring Application Using Low Code Platform	

1. WORK DONE

- Able to web scrape three dynamic hotels from Booking.com.
- Done the automation flow for Agoda.

2. WORK TO BE DONE

- Done the web scrape from Agoda.
- Done the automation flow for Hotels.com.

3. PROBLEMS ENCOUNTERED

- Automation for Agoda still have some error.

4. SELF EVALUATION OF THE PROGRESS

- Spend too much time on testing the automation for Agoda, too dependent on the trial automation for Agoda.



Supervisor's signature



Student's signature

Appendix

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Year 3 Sem 3	Study week no.: 10
Student Name & ID: Tan Kok Han 20ACB06360	
Supervisor: Ts Dr Goh Hock Guan	
Project Title: Development of Hotel Price Monitoring Application Using Low Code Platform	

1. WORK DONE

- Done the system with 9 hotels and web scrape from three different OTA.
- Able to display data to the Node-RED UI dashboard and send message to Telegram.

2. WORK TO BE DONE

- Finalize the report
- Improve the system

3. PROBLEMS ENCOUNTERED

- The date picker is still doesn't work when user input the date.

4. SELF EVALUATION OF THE PROGRESS

- The system is working fine, but the report is not started yet.



Supervisor's signature



Student's signature

Appendix

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Year 3 Sem 3	Study week no.: 12
Student Name & ID: Tan Kok Han 20ACB06360	
Supervisor: Ts Dr Goh Hock Guan	
Project Title: Development of Hotel Price Monitoring Application Using Low Code Platform	

1. WORK DONE

- Report for Chapter 5 and Chapter 6 is finished.
- All the testing had been carried out.

2. WORK TO BE DONE

- Presentation and Demonstration for FYP2.

3. PROBLEMS ENCOUNTERED

- No problems encounter.

4. SELF EVALUATION OF THE PROGRESS

- Things that planned for this two week is done, everything is working as the plan.




Supervisor's signature



Student's signature

APPENDIX

POSTER



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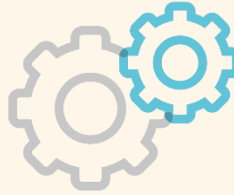
FACULTY OF INFORMATION AND
COMMUNICATION TECHNOLOGY
UTAR KAMPAR CAMPUS

DEVELOPMENT OF HOTEL PRICE MONITORING APPLICATION USING LOW CODE PLATFORM

By: Tan Kok Han
Supervisor: Ts Dr Goh Hock Guan

INTRODUCTION

This project is a monitoring system developed by using Node-RED which used to monitor the hotel price. The Node-RED library is used to web scrape the important details of the hotel and then put it inside the designed Node-RED dashboard.




PROBLEM STATEMENT

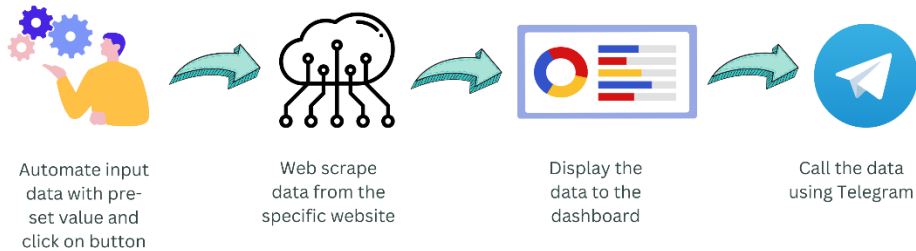
- Price Fluctuations which means hotel prices are fluctuate frequently due to a lot of factors
- User unable to know the changes of the hotel price instantly

OBJECTIVE

- -To allow users to track hotel prices in real-time and scrape it correctly, allowing hotel revenue managers and travelers to make informed decisions based on the most up-to-date pricing information.
- -To develop a system that able to collect pricing data from various sources, such as hotel websites, online travel agencies, and other booking channels, to provide a comprehensive view of the market.
- -To develop a hotel price monitoring system that able to handle large volumes of data and provide fast and reliable performance.




METHODS



```
graph LR; A[Automate input data with pre-set value and click on button] --> B[Web scrape data from the specific website]; B --> C[Display the data to the dashboard]; C --> D[Call the data using Telegram]
```


METHODOLOGY

Agile Model. The system can be break into different small iteration during our development stage, and we can perform testing on each of the small iteration



CONCLUSION

In this project, the Node-RED is involved in the system to monitor the hotel price which can make the user more convenience and can view the real-time data.



Bachelor of Information Technology (Honours) Communications and Networking

PLAGIARISM CHECK RESULT

PLAGIARISM CHECK RESULT

The chapter 1 of the project is Introduction. This section includes the Motivation and Problem Statement, Project Objectives, Project Scope, Main Contribution of the Report and Organization of the Report.

Chapter 2 of the project is Literature Review which is more on discussing the Review of Technologies and Review of the Existing System.

Chapter 3 of the project is System Methodology which consists of system development models, selected system development models, all the requirements of the system, expected system performance, expected challenges, project milestone and estimated cost.

Chapter 4 of the project is System Design which show the system architecture, functional modules in the system, system flow and GUI Design.

Last by not least, Chapter 5 is to do the conclusion for the system.

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 Name: Goh Hock Guan

 Date: 5/9/2023

 Signature of Co-Supervisor

 Name: _____

 Date: _____

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