Analysis of Alternatives

Introduction

Analysis of Alternatives (AoA) is the analytical comparison between a few different alternatives, where decisions are made before committing resources to the project. For this project, Git team is required to work on an inspector for GitHub repositories. There are a few important architectural decisions that are made from evaluating multiple options. The evaluations are for deciding on a programming language, platform applications, project management tool and communication tools. This report justifies and compares multiple options with the goal of choosing the best option.

Review of Analysis of Alternatives

1. Programming Language

In this section, a programming language should be chosen based on the team's experience and knowledge of the language, so that all team members can code and program with ease. Furthermore, the programming language is chosen based on the comfortability of the team on the language. There are a few programming languages that are considered:

- Python
- Java
- JavaScript

These options are considered mainly because most of the team members have previously learned or at least have some knowledge of the programming language. There are a few criteria that are considered, which is general use and specialty, ease of learning, frameworks and easy access of forums, as listed below.

A. General Use and Specialty

Python

Python is widely used for web applications and Artificial Intelligence [1]. It is a fairly new interpreted advanced programming language that supports automatic memory management. Python is also an object oriented programming language and it is built on flexible and robust semantics [2].

Java

Java is mainly used for web applications, mobile applications and embedded systems [1]. Java is an object-oriented and high-level programming language with leading general-purpose application development and framework [1][2]. It contains features that makes it ideal for web-based development [2].

JavaScript

JavaScript is used for web applications and local applications [1]. It is a dynamically typed high-level, interpreted language [1]. Although JavaScript uses Java-like syntax, JavaScript is more towards a client-side programming language, which means it runs inside a client browser and processes the commands on a computer, rather than a server [2].

B. Ease of Learning

Python

Python is a fairly easy to moderate programming language [1]. Python's standard library offers a wide range of facilities and long table of contents list. The Python library contains modules that provide standardized solutions for common problems that occurs daily. Built-in modules which are written in C is also accessible such as file I/O, where it provides access to the system functionality [3].

Java

Java is a moderate to difficult programming language [1]. Java's standard library contains a wide range of packages and list of table of all classes. The Java library contain detailed documentation and developer-targeted descriptions with conceptual overviews that are made easy for new developers. Code examples and definition of terms are also available for learning and problem-solving purposes [4].

JavaScript

JavaScript is a moderate programming language [1]. Unlike other programming languages, JavaScript does not have a standard library. However, Javascript offers a wide range of core libraries for developers to use, for example, jQuery, Dojo Toolkit, Prototype JavaScript Framework and many more [5]. There are different library created for specific uses or task, such as graphical and visualization libraries, graphical user interface and widget related libraries, or data modeling libraries [5]. Despite all these, the most popular library at the moment would be jQuery [5][6].

I. jQuery

jQuery is a JavaScript library used mainly for Document Object Model manipulation which is known as the DOM. It can be used to create DOM elements, event handling and animation creation [6]. It is simple to use as it removes all cross-browser incompatibilities while supporting the separation of Hypertext Markup Language (HTML) and JavaScript, by providing working Application Programming Interface (API) [6].

II. Dojo Toolkit

The Dojo toolkit is a JavaScript library that is designed to rapidly creating an Ajax-based websites [7]. It also supports cross-platform applications. Additionally, the purpose of Dojo toolkit is to make the development process easier and faster by using the Web standards as the platform [7]. It also contains independent and lightweight modules, at the same time optimizing the use of Cascading Style Sheets (CSS) and JavaScript [7]. At the same time, the simplification of browser compatibility is shown as API's are already provided [7].

III. Prototype JavaScript Framework

Prototype Javascript Framework is a JavaScript library that allows DOM elements to be manipulated over cross-browser [8]. It aims to make the development of dynamic web applications easier. Unlike jQuery and Dojo Toolkit, Prototype extends DOM elements and have built-in types with useful methods [8]. Besides, it also supports event management, and provides API's with powerful Ajax features and DOM element [8][9]. However, it does not provide the full set of algorithms or I/O systems [8].

C. Easy access of forums

Python

Issues regarding Python can be easily solved as there are many forums with open source supported by Python developers communities. Since Python is a rapidly growing programming language [10], it is most likely similar problems can be found. New problems regarding projects can be posted on forum like python community, where there are 84% users who use Python as their main programming language [11]. Alternatives forums are Stack Overflow and Python Forum.

Java

Common problems of Java can be found easily as there are many Java forums such as Java Community Space Forum, CodeRanch, Java Forum and Oracle Community. Resources of Java problems are plentiful as the Java forums are very active and suitable for all expertise level [12]. Most of the Java forums also offers a large range of different topics which helps new Java developers with their problems. Alternatives forums are Stack Overflow.

JavaScript

JavaScript's problem can be easily found as there many active forums such as Stack Overflow, WebDeveloper.com, and SitePoint. Since JavaScript is the most popular language according to Stack Overflow and GitHub [10][13], resources are easily available. Alternative forums are GuruQuest and Reddit.

Final comparison table for programming language

	Python	**Java**	**JavaScript**
General Use and Speciality	Web applications and Artificial Intelligence	Web applications, mobile applications and embedded systems	Web applications and local applications
Ease of Learning	Fairly easy to moderate	Moderate to difficult	Moderate
Presence of standard libraries	Yes.	Yes.	No, instead there are many other libraries like jQuery, Dojo Toolkit and Prototype Javascript Framework.
Easy access of forums	Yes, python community, Stack Overflow and Python Forum.	Yes, Java Community Space Forum, CodeRanch, Java Forum and Oracle Community.	Yes, Stack Overflow, WebDeveloper.com, and SitePoint.

2. Platform Application

In this section, platform application is chosen mainly based on the project's targeted audience. For this project, the client is our targeted audience, hence, the platform application will be chosen based on the client's needs and comfortability, so that client is able to use the application on their desired platform. There are a few platform applications that are considered:

- Desktop application
- Web application
- Mobile application

These options are mainly considered because the project is suitable to be programmed on these platforms. There are a few criteria that are considered, which is operating system or browser used, maintenance and response time, as listed below.

A. Operating System/ Browser

Desktop application

Desktop applications are any software that can be installed on a single computer that are used to perform specific tasks [14]. Users can download the application on their computers and directly use and access it. However, desktop applications are designed based on their compatibility with the operating system. There are some desktop applications that only support one operating system. While there are also applications that can support multiple operating systems, this is because these are cross-platform applications like Xojo [15]. The type of operating system that is able to support desktop applications are Windows OS, Linux OS, Chrome OS and Mac OS.

Web application

Web application is a computer program that performs a specific function by using a web browser as its client, which can be accessed with the presence of internet [16]. Unlike desktop and mobile application, web application does not need an operating system to run, it can be assessed from a browser. There are a few browser's services that can be used and supported, which is Google Chrome, Mozilla Firefox, Microsoft Edge, Safari and Opera.

Every web browser supports the basic HTML with CSS and Javascript available, although some only support basic HTML [17].

Mobile application

Mobile application is a software application designed to be used on a mobile platform [18]. Different mobile application also runs on different operating systems, although some mobile application supports on cross-platform. Examples of mobile operating systems are Android OS, iOS, Bada, Blackberry OS and Windows Mobile. The most frequently used and popular would be Android OS and iOS [19]. Android mobile applications are usually developed using Android Studio where the main programming language used is Java [20]. Whereas, for iOS mobile applications offers an application called Xcode with built-in Swift 5 as their main programming language [21].

B. Response time

Desktop application

Desktop applications are usually downloaded on a desktop or laptop computer. Once downloaded, the application can be accessed from the monitor itself. Desktop applications generally provide the richest user experience and are a great choice, however, desktop applications need to be very responsive [22]. Programs need to react immediately to user's action as any delay in the middle of an action could ruin the user's experience. Besides, it is also stand alone in nature, where the internet connectivity will not affect its performance and response time [23].

Web application

Since web application can be accessed from the browser itself, the responsiveness is very dependent on the Internet and the server itself [22]. In most cases, if there is an unstable internet connection, the webpage cannot not be accessed or the webpage could load very slowly. This can brings bad experience for users.

Mobile application

Mobile applications are downloaded locally on the user's device. Just like desktop application, mobile applications can be fast and responsive [22]. Some mobile application requires active internet connection, where responsiveness will be determined by the internet connection. On the other hand, there are some mobile applications that can be used offline, hence the responsiveness will be fast [23].

C. Maintenance

Desktop application

Desktop application can be maintained easily because once an update is released, with the presence of active internet connection, the application can be self-updating. Regardless, even without updating the desktop application, users can still use the application on their computers. Users can choose not to update the application and keep using the previous versions. Moreover, there are also the ClickOnce Application, where if any newer version update is available, they would automatically replace any update files [24]. This has made it easier for users, at the same time, without affecting their experience.

Web application

Web applications can also be easily maintained as maintenance is done in the server itself. Hence, no matter what browser or platform a user uses, they would be able to view the latest version of the web page automatically. However, a user will not be able to access the website if the website is undergoing maintenance. Users can only use and access the website after the website's maintenance is done.

Mobile application

Mobile application maintenance is rather easy because when an update is released, users can update the application via their mobile apps store. It is similar to the way a desktop application updates, the applications differ as mobile applications are not self-updating by default. Users are required to update their application manually. A simple click on the update button will automatically update the application.

Final comparison table for platform application

	Desktop Application	Web Application	Mobile Application
Operating System/Browser	Runs on operating system such as Windows OS, Mac OS	Runs on browsers such as Google Chrome, Mozilla Firefox, Microsoft Edge, Safari and Opera.	Runs on operating system such as Android OS, iOS, Bada, Blackberry OS and Windows Mobile.
Response Time	Very fast	Slow, dependent on the server and internet connection.	Fast
Maintenance	Easy to maintain	Easy to maintain	Easy to maintain

3. Project Management Tools

In this section, project management tools are chosen mainly based on their functionality and their simplicity to clearly show the team members their responsibilities and progress on the project. There are a few project management tools are considered:

- Trello
- Kerika

There are a few criteria that are considered, which is features, availability and cost as listed below.

A. Features

Trello

Trello uses the Kanban system where a board is separated into three sections which is the "To Do", "Doing" and "Done" section. Trello consist of a system of boards, list and cards [25]. This allows team members to keep track of each other's contribution and which task they need to finish first. Trello also uses "drag and drop" system where each task can be assignment to different list by just "drag and drop" into another list, assigning team members to specific task also can be done through "drag and drop" [25]. Time tracking functionality is also available where team members can assign due dates to tasks and keep track of when the task has been completed using their built in calendar feature. The Kanban boards are also available in private mode, where only people with access can edit and view. In addition, you can create a team and assign it to the project.

Kerika

Kerika offers users to create three types of boards, which are the task board, scrum board and whiteboard [26]. Unlike trello, Kerika adopts and adapts Agile to a user's desired interface. For each board, team members can change the title of the task instead of having fixed titles. Each card can have sub-cards and the cards can have specific work items. it also offers the feature to switch from Scrum board to Kanban board and linking cards between boards with a single click [26]. Kerika can also assign each member to a specific task and set due dates for each task. Given a due date, a notification will pop-up if the task remains incomplete close to the due date [26]. Kerika uses Google Calendar to keep track of the date of the task. Similiar

to Trello, Kerika uses “drag and drop” system to manage the task. The boards are also available in private mode, and it can assign different team members to different projects.

B. Availability

Trello

Trello is available on all platforms, whether it is websites, mobile applications or desktop [27]. Trello is also supported in different modern browsers. Browsers that are frequently visited by many, are Chrome, Firefox, Microsoft Edge and Safari [27]. Users can keep track of their progress wherever and whenever they want. This makes it easier as users do not have to carry their computers or laptops around to get themselves up-to-date, they could just simply download it on mobile devices.

Kerika

Kerika is only available on web application. Unlike Trello, kerika can only be access on web browsers.

C. Cost

Trello

Trello is free. However, to unlock the full features, users are required to pay $12.50 monthly [28]. For the free version, users can only create 10MB per file attachment for personal boards. They also allow users to create 10 Team Boards.

Kerika

Kerika is also free but for a limited time. Unlike Trello, Kerika’s free version is full featured [29]. Users are able to access every feature in Kerika. Kerika also offers free subscription for students, teachers and non-profit organizations [29]. Users just have to request the free non-profit and academic subscription by using their academic email and they can use it for free [29].

Final comparison table for project management tools

	Trello	**Kerika**
Features	● Kanban boards template only. ● "Drag and drop" feature available ● Assigning to each member feature available ● Keep track of due dates feature available ● Calendar feature available	● Task board, scrum board and whiteboard templates. ● "Drag and drop" feature available ● Assigning to each member feature available ● Keep track of due dates feature available ● Able to sync with Google Calendar
Availability	Available in platforms, which are, web application, mobile application and desktop application	Only available in web applications
Cost	Free, but limited feature.	Free with all features.

4. Communication Tools

Communication tools are used to help communicate between the team members. Communication between team members is important because they could update each other on their part of the project or notify the team if they are sick. There are a few communication tools considered:

- Whatsapp
- Facebook Messenger

There are a few criteria that are considered, which is features and limitations of the apps.

A. Features

Whatsapp

Whatsapp is a very popular communication tool among people. This is because whatsapp has features that help in effective communication. Whatsapp supports audio recording and video recording, this feature helps to deliver messages when someone is in a hurry. It also has end-to-end encryption, hence, there will not be any privacy data leaks [30]. Group chats can also be created and media can be sent in the form of images, video, audio and documents. The platforms that Whatsapp supports are Android OS, iOS, Web, Mac, Windows and Windows Phone. Whatsapp also has read receipts, which tell user if the message is read by the reader [30].

Facebook Messenger

Similar to Whatsapp, Facebook has features such as audio recording, video recording, read receipts and group chats. The difference is that Facebook transfer of media in the form of images, video, audio, documents, emoji and stickers [30]. Also, only a few platforms support the use of Facebook, which are Android OS, iOS and webpages or browsers. Facebook also supports cloud sync. This allows users to store their information into a cloud storage [30]. It also allows user to share any file size according to the user's device.

B. Limitations of the apps

Whatsapp

Whatsapp limits the number of images that users can send at a time. Users can never send more than 30 pictures at the same time [31]. Whatsapp accounts also can only be used on one device, this is because the account is tied to the phone number of the device. Besides, Whatsapp has limitation on shareable file sizes, which is only 16 Mb limit.

Facebook Messenger

Facebook Messenger lacks privacy control. Any information sent into the messenger can be used and accessed to sell the information to advertisers [31]. Facebook Messenger also lacks end-to-end encryption.

Final comparison table for communication tools

	Whatsapp	**Facebook Messenger**
Features	● Audio recording ● Video recording ● Read recipient ● Group Chats ● End-to-end encryption ● Media sent in forms of : images,video, audio, documents ● Platform supports: Android OS, iOS, Web, Mac, Windows and Windows Phone	● Audio recording ● Video recording ● Read recipient ● Group Chats ● Media sent in forms of : images, video, audio, documents, emoji and stickers ● Platform supports: Android OS, iOS and webpages or browsers ● Supports cloud sync ● Sharing file of any size depend on user's device
Limitations of the apps	● Limits the number of images sent at a time ● Can only be used on one device ● Limitation of 16 Mb of file size	● Lacks of privacy control ● No end-to-end encryption

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Architectural Decisions

Introduction

In this section, decisions for this project are made based on the analysis made in Analysis of Alternatives. After considering all of the suggested options and criteria, decisions were made for programming language, platform applications, project management tool and communication tools. This report concludes and justifies the decisions made.

Summary for Analysis of Alternatives

For programming language, our team has decided to choose Javascript for this task. This is because all of the team members have sufficient knowledge and have previously learned Javascript. Besides, Javascript is a moderate programming language, which can be learned quickly. Since Javascript does not have its own standard library, we will be using the alternative libraries which is jQuery. Our team chose jQuery as it is well-documented and most of the modern Javascript developer uses it. Hence, seeking professional help from the communities would not be a problem, where forums are also readily available and active. Hence, Javascript will be the back-end programming language, while HTML and CSS would be the front-end language. Our team also concluded that we had enough confidence to code with Javascript. Moreover, Javascript can be used to develop web applications, which brings us to the next important decisions.

Secondly, our team choose web application for our platform application. The main reason web apps was chosen because it can be easily accessed from any device or computer. Clients are able to use the application via browser as every computer and device has a built-in browser by default. Although web applications are slower compared to other platform applications due to their dependency on internet connection, it is extremely easy to maintain.

Next, we chose Kerika as our project management tool. Kerika offers many types of Agile boards to work with, which include custom scrum boards and kanban boards. In addition, our team tried exploring Kerika and found it was extremely easy to use. There are many additional useful features like making notes on each card and creating sub-cards to break down the task into smaller parts. In Kerika, we are able to keep track of our own tasks,

assign new tasks and rename the boards instead of using the fixed name boards. Most importantly, Kerika is free for everyone to use with full features available. We even managed to get the free academic subscription, so we do not need to worry about the free trial ending half-way through the project.

Finally, we've decided that Facebook messenger would be our main communication tool. Our team also agreed to use Whatsapp as our secondary communication tool, just to make urgent calls. It is only used as a back-up if some urgent or important decision needs to be made, and a call needs to be made, because not all members are from Malaysia. Facebook messenger is chosen because it supports transfer of unlimited photos and documents of any file size. Our team ignored the fact that Facebook messenger had privacy security issues as it is not our main concern. On the bright side, team members would not face any problems sending or receiving large document files, and most of the team members are very active on Facebook messenger, which indicates active communication can be carried out.

In conclusion, Javascript would be used as our back-end programming language, HTML and CSS would be our front-end language. Web application is chosen as the working platform application, and Kerika will be used as our project management tool. Last but not least, Facebook messenger is the team's communication tool.