CHAPTER II

LITERATURE REVIEW

2.1 Decision Support System

Decision support system like its name, is a system that help users for making a decision, by using a program to help solve certain problems through deciding the most accurate choices as possible according to the method chosen and therefore solve problems by figuring out solutions [7]. These computerized program capable of calculating which decision to be made according to the weight or criteria or alternative that is chosen, and that calculation then is implemented inside either into a program or system or website [8]. Most researcher begun researching about decision support system around year 1960, they research about how computerized program could actually help in decision making, and at 1969 Ferguson and Jones managed to do an experimentation on decision making aided by computer [9]. By now decision support system has advance so far as to decide critical decision such as employee performance appraisal [10], to evaluate a clinical decision in psychological therapy [11], and even it can help to make a decision based on predicted clinical diagnose [12].

2.2 Simple Additive Weighting

Simple Additive Weighting or SAW is method in decision support system that can calculate what choices should one make based on their preferred criteria and weight to get the most accurate alternative or solutions [13]. SAW method requires to determine the criteria and weight from the get go, and by using those criteria weight, then decision matrix (X) made with character as (A_i), criteria as (C_i), and (w) for weight, will be normalize based on the type attributes. Lastly, the total score for the alternative is obtained by summing all the results of the multiplication between the ratings [5] [14].

SAW uses multi-attribute decision making, such as benefit attribute and cost attribute. Benefit attribute is an attribute when the higher the value of the

criteria, the better the decision, which in equation is represented as max. While cost attribute is an attribute when the higher the value of the criteria, isn't the better decision, which can be symbolize in equation as min [13].

$$r_{ij} = \frac{x_{ij}}{\max x_{ij}} \qquad r_{ij} = \frac{\min x_{ij}}{x_{ij}} \tag{2.1}$$

Formula 2.1 above are the equations of formula for normalizing the criteria weight. r_{ij} is the decision matrix resulting from the normalization equation, x_{ij} is the value of the chosen criteria, $\max x_{ij}$ is the maximum value of the criteria used for benefit attribute, and $\min x_{ij}$ is the mi-um value of the criteria used for cost attribute.

$$V_i = \sum_{j=1}^{n} w_j r_{ij} \tag{2.2}$$

The formula 2.2 above is the equation for ranking each alternative, whereas represented as the result V_i and $w_j r_{ij}$ means w for weight multiple by normalizing criteria weight from the previous equation.

2.3 Prototype

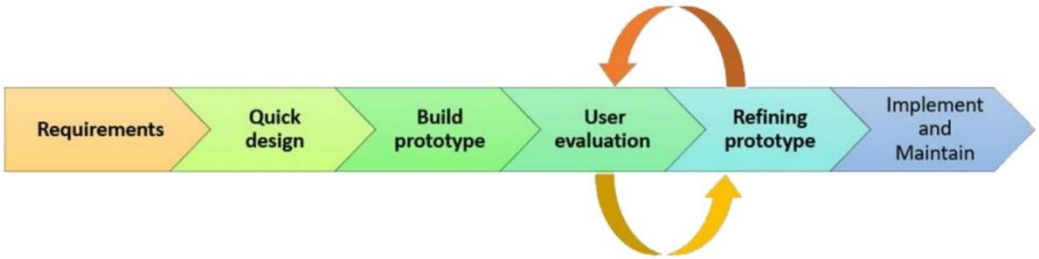


Image 2.1 Prototype Model [6]

Image 2.1 above is the Prototype method model, prototype is a framework with a development process that allows the involvement of its user. This method has six steps, such as requirement, quick design, build prototype, user evaluation, refining prototype, implement and maintain [6].

1. Requirement

   Refers to information gathering or project initiation, because the first things that should be done are gathering the information necessary before developers starts the projects. Understand what kind of data that are needed or what information that the developers need to be aware of when developing the projects. This requirement gathering can be done by communicating with the users about the projects purposes or needs.

2. Quick Design

   After the necessary information is obtained, the next thing is to start planning, by doing a quick design of the overall system, and to show it to the users. Even though it will not be a complete or finishing design, the user will have some kind of an idea of how the system will be, and so help to develop a prototype.

3. Build a prototype

   This step is where developers start begun to works on the project, using the information obtained from the users. By doing so it will help both developers and the users to know more about the system, therefore find what it may be lacking for further improvement.

4. User Evaluation

   This methodology tried to make the users to be involved as much as possible, and therefore in this step, the users will have to evaluate the prototype of the systems. From this step user will give comment and suggestion, whether the system's function can cover their needs or not.

5. Refining prototype

   If by any chance the prototype's weakness is too much, or unable to cover the user's needs, then developers will have to refined, or remake the systems according to the user's suggestion, comment, and need. Although this step could be redo over and over again until the user's need is fulfilled.

6. Implement and Maintain

Once the systems have completely finished in accordance with the user's wishes, the system will be tested and deployed for use. The system will still undergo maintenance to avoid any too-far-gone failures.

2.4 Web-Based System

Web-Based System is a system that makes full use of a website that focuses on helping or supporting the activity of humans or users or business that needs it in the field of technology [15]. Most of the time, beside application, website is the best way to support user's need, whereas website itself is a place in the internet where everyone can access, with its purpose is not only to create online shop and to buy or sell, but also just to be informative, to give the viewer what information that they would like to know and in the end will help the viewer on decision making [16]. Web-Based System is precisely taking full advantages of that, due to the limitation of human's activity, a system was made using website as its based, to support their activity or decision making.

2.5 HTML

HTML or Hypertext Markup Language is a programming languages specifically design for the use of creating and developing a website. This particular programming language allows the developers to give sets of instructions or commands to design or make web pages. What users usually see when they are visiting a website are the works of HTML, it consist of every button, a-ation, design, wording, font, table, pictures or video, and most of the features [17].

2.6 PHP

PHP or Hypertext Preprocessor is a free to use and flexible scripting language designed for the web development, and PHP language is embedded inside HTML script or language. While PHP is inside the HTML script, Its was specifically design to allow easy access with the database server, to have features that allow the website to be dynamic and actually capable of making the web works or running [18].

2.7 MySQL

MySQL is a database that allows the users to store, retrieve, sort, and search for the information or data inside it. It uses a standard language database query language called SQL or Structured Query Language and has been free to use since 1996. Even though it has been around for around 20 or so years, it still is a database with fast/high performance, can be use with various operating system, and an open source application [18].

2.8 XAMPP

XAMPP is a tools that can provided many other tools in one packet, such as Apache, PHP, MySQL, and phpMyAdmin. This tools is used specifically when developers wish to develop or test an application or website they made, that must connect with a database, or in some cases the MySQL or phpMyAdmin [19].

2.9 Visual Studio Code

Visual Studio Code is an open source and free code editor that can be used by various programming languages. This code editor has a lot of extensions, therefore have a lot of features and can support the program writing such as handling errors, debugging, extensible, customization, and have IntelliSense. IntelliSense is a feature in Visual Studio Code that provide auto-completion based on the predicted word, variables, function definition, imported modules, and extensions [20].

2.10 Unified Modeling Language

Unified Modeling Language or UML is a standard language for object development and can be used to visualize or documenting the planning of software development system, in the form of diagrams. Even though UML is a standard language, it is not exactly a language, it is a model to help develop a basic concept of software or web development. UML diagrams or model always uses the exact same diagrams or models, even in different country or places, therefore it is called a standard language [21] [22].

2.10.1 Use Case Diagram

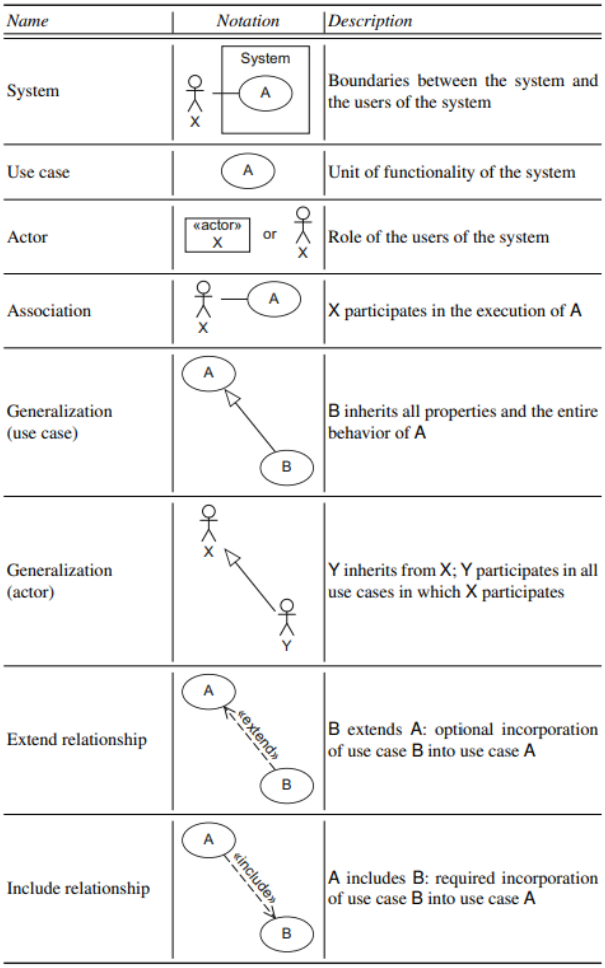


Image 2.2 Notation Use Case Diagram
Source: [22]

Image 2.2 above is the notations of Use Case Diagram, that is one of UML's diagrams that focuses on identifying functional requirement, such as identify who is the actor, what function will be needed, and what kind of process that will happen in the system. Use Case helps identify these kinds of things, making planning easier, and by making a quick design of the overall concept, the future user will be able to know how the system will be in the end [21] [22].

2.10.2 Activity Diagram

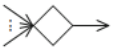
Name	*Notation*	*Description*
Action node	Action	Actions are atomic, i.e., they cannot be broken down further
Activity node	Activity	Activities can be broken down further
Initial node	●	Start of the execution of an activity
Activity final node	◉	End of ALL execution paths of an activity
Flow final node	⊗	End of ONE execution path of an activity
Decision node		Splitting of one execution path into two or more alternative execution paths
Merge node		Merging of two or more alternative execution paths into one execution path
Parallelization node		Splitting of one execution path into two or more concurrent execution paths
Synchronization node		Merging of two or more concurrent execution paths into one execution path
Edge	A → B	Connection between the nodes of an activity
Call behavior action	A	Action A refers to an activity of the same name
Object node	Object	Contains data and objects that are created, changed, and read
Parameters for activities	Activity	Contain data and objects as input and output parameters
Parameters for actions (pins)	Action	Contain data and objects as input and output parameters

Image 2.3 Notation Activity Diagram
Source: [22]

Image 2.3 above is the notations of Activity Diagram and Activity Diagram is one of UML's diagrams that focus on the state or action of the system that shows series of actions that happens accordingly from the how the users will uses the system. This diagram will help to identify the flow of those actions and show them in diagrams, therefore it will give a clear view of what should be made in the prototype or web development [21] [22].

2.10.3 Class Diagram

Name	*Notation*	*Description*
Class	A – a1: T1 – a2: T2 + o1(): void + o2(): void	Description of the structure and behavior of a set of objects
Abstract class	A {abstract} A	Class that cannot be instantiated
Association	A — B (a) A ⟷ B (b) A → B (c)	Relationship between classes: navigability unspecified (a), navigable in both directions (b), not navigable in one direction (c)
N-ary association	A, B, C	Relationship between *N* (in this case 3) classes
Association class	A, B, C	More detailed description of an association
xor relationship	B, C, {xor}, A	An object of A is in a relationship with an object of B or with an object of C but not with both
Strong aggregation = composition	A ◆— B	Existence-dependent parts-whole relationship (A is part of B; if B is deleted, related instances of A are also deleted)
Shared aggregation	A ◇— B	Parts-whole relationship (A is part of B; if B is deleted, related instances of A need not be deleted)
Generalization	A —▷ B	Inheritance relationship (A inherits from B)
Object	o:C	Instance of a class
Link	o1 — o2	Relationship between objects

Image 2.4 Notation Class Diagram
Source: [22]

Image 2.4 above is the notations of Class Diagram and that is one of UML's diagrams that focus on the detail or connection from each element. There are many elements that can arise in this model, and each of these elements will have their own name, attribute, and generalization. There can be little or many elements that can arise from one system, but each of these elements will surely without a doubt have at least one connection or association from other element [21] [22].

2.11 Attributes (Stats)

Attributes or can also be called Stats is the value given to fictional characters or items for describing their combat capability, how powerful they can be, their survivability when fighting against monsters/enemy. In game Genshin Impact, Stats can be found from characters, weapons, and artifacts. Stats in weapons and artifacts, they are already determined from the start, so player can only build Stats' characters. Player can build their characters depending on what kind of weapon and artifacts did they choose for that character. There are quite a lot of Stats in a character's details profile that must be taken into account for, such as [23].

1. Max HP

   Max HP or Hit Point is the total of HP that certain characters have, how much health are they actually have to endure the damage inflicted from their enemy. Max HP is the accumulation of HP (with an integer value) and HP% (with a percentage value).

2. ATK

   In character's detail profile, ATK is there to show how much Attack value a character had or damage can one character can inflict. A character have their original basic Stats, that will increase each time a player level up that characters. But most likely players will increase these basic Stats even further, with the help of weapons and artifacts. ATK in here is the accumulation from basic Stats, ATK and ATK% that come from weapons and artifacts.

3. DEF

   DEF is the abbreviation for Defense, and this is used to measure how much damages from enemy can be reduced. So the higher a player's character's DEF is the less damage they received. Just like before, there are three things that can increase DEF in character details, that is basic Stats, DEF, and DEF%.

4. Elemental Mastery

"The higher a character's elemental mastery, the stronger the elemental energy that can be released" is a quote from an in-game explanation about Elemental Mastery. Elemental Mastery is a Stat that allows characters to inflict damage against enemy using their elemental reaction. In Genshin Impact, there are seven elements, and if these elements are pitted against the others, a reaction will be achieved. For example, pyro (fire) against hydro (water) will result in vaporization, hydro (water) against cyro (ice) will result in frozen, or swirl reaction that came from anemo (wind) against all elements, that is anemo (wind) can intensify those elements on enemy.

5. CRIT Rate

   CRIT Rate is a chance of how likely one's characters able to hit critically and give a critical damage bonus. CRIT Rate is shows as a percentage and the basic or default Stats for CRIT Rate is 5%. So if a player builds their character to have CRIT Rate of 100%, it is a guaranteed for that character to have critical damage every single hit or blow. Unlike before, CRIT Rate here only have two to accumulate the total CRIT Rate, default also percentage from weapons and artifacts.

6. CRIT DMG

   CRIT DMG is the abbreviations for critical damage, it is the critical value that shows when a critical hit occurs. Just like CRIT Rate, CRIT DMG also shown in percentage, and it also only have two to accumulate the total CRIT DMG.

7. Healing Bonus

   Healing Bonus is shown as a percentage value, and inside the game Genshin Impact, there are some characters with healing ability. So Healing Bonus is determining the bonus of a character's healing ability, it can increase the fastness and the value of healing a certain character. Healing Bonus can be increase only from artifacts, as there are no default Stat for it, and no weapon shows any Stat as well yet.

8. Energy Recharge

   In game Genshin Impact, characters have ability called Skill and Burst. Skill can be use after every cool down timer, but Burst can only be use after the Skill is used for certain times. Energy Recharge can be use to make the accumulation of used Skill for Burst to be faster, since for most characters Energy Recharge is essential. Energy Recharge can be increase from weapons and artifacts, also come from default Stats.

9. Elemental DMG

   In game Genshin Impact, currently there are 7 types of elemental damage a character can have, that are; (fire) Pyro DMG Bonus, (water) Hydro DMG Bonus, (plants) Dendro DMG Bonus, (electric) Electro DMG Bonus, (wind) Anemo DMG Bonus, (ice) Cyro DMG Bonus, and (earth) Geo DMG Bonus. Naturally, a character's elemental damage will correspond with their own elemental type or the in-game term is vision.

2.12 Previous Research

Table 2.1 Previous Research Analysis

No	Journals	Methods	Research Results
1.	**Article Title** The Implementation of Simple Additive Weighting (SAW) Method in Decision Support System for the Best School Selection in Jambi, Vol. 1338, No. 012054. [24] **Journal Names** Journal of Physics: Conference Series **Year** 2019 **Authors** Ibrahim A, Surya R A	Research method used in this research is Simple Additive Weighting (SAW) with the chosen criteria are school achievement, school environment, school accreditation, implementation of the curriculum, and Availability of Extracurricular Activities	The result of this research is a web-based decision support system which able to choose the best school in Jambi City by its Education Office using SAW method. The results show easier and more simpler processing of selecting the best school data.
2.	**Article Title** Decision Support System For Employee Bonus Determination With Web-	Research method chosen for the decision support system in this research is Simple	The result of this research is a website that can giving bonuses to the employee in PT. Mayatama Solusindo

No	Journals	Methods	Research Results
	Based Simple Additive Weighting (SAW) Method In PT. Mayatama Solusindo, Vol. 2, No. 1. [8] **Article Name** Journal of Applied Engineering and Technological Science **Year** 2020 **Authors** Yuda Irawan	Additive Weighting (SAW) with the chosen criteria are Supervisory Assessment, Length of Work, Attendance and Warning Letters, and data storage. The methodology that was used for the development of the website is Waterfall method	accordance with its criteria much easier compare to the old database system.
3.	**Article Title** Analysis of Decision Support System in Determining the Nutritional Status of Toddlers Using Simple Additive Weighting, Vol. 14, No. 1. [13] **Journal Name** CommIT (Communication & Information Technology) **Year** 2020 **Authors** Ofan Sofian, Joseph Joseph, Fauziyah Fauziyah	The research method use in this research is Simple Additive Weighting (SAW) with the criteria chosen for it are weight, height, and age.	The result of this project is a decision support system that capable of determining the nutritional status of toddler accordance with the criteria. That is there are 0 with the status of malnutrition, 3 as nutritional deficiencies, 19 with a medium nutrition, 28 with a good nutrition, and there are 10 who have more nutrition then the others.
4.	**Article Title** Gaming Mobile Selection with Decision Support System using Simple Additive Weighting, Vol. 29, No. 4. [25] **Journal Name** International Journal of Advanced Science and Technology **Year** 2020 **Authors** Agus Wibowo, Vera Septi Andrini Tri Wahyuni	Research method for this project is Simple Additive Weighting (SAW) with five chosen criteria, that are price, RAM, ROM, screen, and weight	The result of this project is that this decision support system project capable of determining which mobile gaming suit for which the handphone for its users. According to the research paper, the best handphone is Razor Phone 2 (A5) and the worst to play the mobile gaming is Redmi Note 7 (A7).

No	Journals	Methods	Research Results
	Maduretno, Lusi Rachmiazasi Masduki, Supiyandi		
5.	**Article Title** Perancangan Website untuk Menentukan Produk Paling Banyak Terjual di Bengkel Man Motor Metode TOPSIS, Vol. 11, No. 2. [26] **Journal Name** ULTIMA InfoSys: Jurnal Sistem Informasi **Year** 2020 **Authors** Vienne Anggelica Kurnia, Aldo Erianda, Dwiny Meidelfi	Research method for this project is Technique For Others Reference by Similarity or TOPSIS and method for system analysis is PIECES framework	The result of this project is a website created using PIECES framework that allows user to add and edit criteria weight, alternative, also show the result of the calculation of the decision support system using TOPSIS by ranking the alternative.

All five previous journals above are systems that was made primarily for decision making, therefore their goal is to help users to make a decision by giving them results based on criteria or alternative that they have selected, and each of them are using Simple Additive Weighting as the method and calculation for the decision support system. While this research project aims mainly for fans or players of a game called Genshin Impact using Simple Additive Weighting for its decision support system calculation to helps fans choosing which characters is the best and therefore which should they pull on the next banner. It is believed that there hasn't any web-based decision support system on choosing Genshin Impact's characters yet. The first four journal all using SAW method, journal [8], and although journal [26] is using method TOPSIS, it is implement by using a web-based system, which is why the five above journal will be a great and helpful references for this research project.

This project does not use any new method for its implementation, and only SAW method for the calculation will be used to rank the character which later will be shown in the website. As a web-based though, this project does have some new

features that the previous journals doesn't do yet, that are the function to "Compare". User can select at least two characters from the rankings, and the ranking then will show only those two selected characters.