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Forest Tree Structure in Classification Learning Media of Animals and Plants World based on Android

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Abstract: Living things on earth are very diverse and important for human life, thus it needs to be preserved and studied by classification. Classification is a group of living things based on characteristics equations. The diversity of animal and plant makes classification less practical and effective if only learned from books. The Taxonomy Application was created to address the issue by applying the Forest Tree Structure into the Android platform. The Forest Tree structure is used to create taxon model in stages from the highest (Kingdom) to lowest (Species) level. This application contains a search feature and display information such as description, characteristics, images, references, and the taxonomic levels of the taxon. The test results showed that 61% of users strongly agree that the application can perform well, 60% agree with the user interface aspects, 70% agree that the application are providing education, 54% agree it should be published and can be used as media to learn about classification.

Keywords: Classification, Animals, Plants, Forest Tree, Android.

1. Introduction

Living things on earth are very diverse. The total number of species is estimated around 10 million to over 100 million [1]. There are over 1.2 million species that has been catalogued in a central database [2]. These living things are important for human life, thus it needs to be preserved and studied by classification. In Biology, the classification of living things is known as taxonomy. Taxonomy is the study about classification of living things based on equal characteristics and give a name to the group [1]. Living things are grouped into taxa (singular: taxon) and these groups are rated taxonomically [1]. The classification uses Linnaeus System consisting seven levels, from highest to lowest level such as kingdom, phylum, class, order, family, genus, and species [3].

The diversity of animal and plant makes classification less practical and effective if only learned from books. The scientific article about the taxonomy has existed in print and electronic media, but only a few software or applications that are easily understood by user [4]. At this time many teenagers use Smartphone. The main factors of increasing the use of smartphones are psychological aspects, easy access to internet, and addiction [5]. The use of smartphones is the most effective and efficient learning to deliver the opportunity because information can spread quickly through the media [6]. This study aimed to develop a medium of animal and plant classification learning by utilizing the use of smartphones among teenagers as a practical and effective application for classification learning.

Research on animal or plant learning media has been done several times. The first research conducted in 2015 is learning applications called smart themes that have several learning themes including limbs, animals, and theme about the plant's parts for children. The study about the theme of plant's parts in this study shows the introduction of the parts found in plant, such as roots, stems, leaves, fruits, and flowers [7].The second study explains the introduction of some animals using Android-based Augmented Reality Technology for

children. This study aimed to enable students in learning about animals to be seen as real by looking at the three-dimensional objects of animals in the application [8]. The third study of animal learning is by applying the game in the form of questions about animal morphology for children. The result of this research is an application that can display information in encyclopedia form containing Latin name, food, place of living, unique fact, class, description, and quiz game features in the form of animal questions. The weakness of this research is that has not applied the methods and algorithms to support the application [9]. The fourth study is a learning media at the level of plant species and introductory plant species for children. The result of this research is a learning media for introduction of plant species only for children based on multimedia with display of text, image, video, and game of crop naming puzzle [10]. The fifth study is about classification learning with species search feature and scientific naming of plants based on Android. Search can only be done at the species level and only display species information [11]. The sixth study in 2016 proposed classification only in the Animalia class level. The Application only showed display of images and text about the class on Animalia [12]. The seventh study of classification learning is a dictionary. Brute Force Methods and Autocomplete Features are used to search for Latin meaning in animal and plant species. Brute Force is used to search for word equations, while the Autocomplete feature in this application serves to facilitate the search for the meaning of the word without having to type the whole word. The applications in this study only show species information of animals or plants and do not display the taxonomic levels of the animals or plants [13].

Previous research encourages the development of a classification learning application that is not only used as a search or display information on the species, but also classification learning that can display hierarchical taxon levels. The previous research has not shown the level of hierarchical taxon appearance, thus the Forest Tree Structure method is required. Tree is a data structure that is hierarchically and has one to many relation [14]. Tree animals and tree plants have their own tree. That collection of trees called forest tree [15]. The application of the Forest Tree structure can facilitate classification learning because it displays the hierarchical taxon from the highest (Kingdom) to lowest (Species) level and makes it easier to see the interrelationships of taxa. Applications also include search and display information about the description, characteristics, images, references, and levels of the taxonomy of these taxa.

The application of tree structure has been successfully performed in previous studies, including a research on the history of the *Kawitan* Temple by implementing Tree Structure as the basis of web-based search [16], implementation model of *Gambelan* Bali with tree diagram [17], Census information system in Bali (E-Banjar) using a web-based Family Tree method to determine the family tree in an organization [18], *Yadnya* ceremonial modeling using an Android-based tree diagram [19], modeling snack categories in Android-based application [20], and the tree structure can be applied in Android Mobile-based Geographic information systems in finding correlations between *Kawitan* temples [21].

2. Research Method

2.1 System Design

Taxonomy Application consists of two sides; the server (admin) and client (user) that are connected through the Internet. Figure 1 shows the system's design overview. Admin and user are not connected directly, but through the exchange of data online using web service. Admin is in charge to make the management process of insert, update, or delete the data on the website of animal or plant online. Data that is managed by

administrators is stored in the database server. Taxonomic data of plants and animals is distributed via internet with the help of web service. Web service will transmit data of taxonomy information of animals or plants requested by the user through Android smartphone.

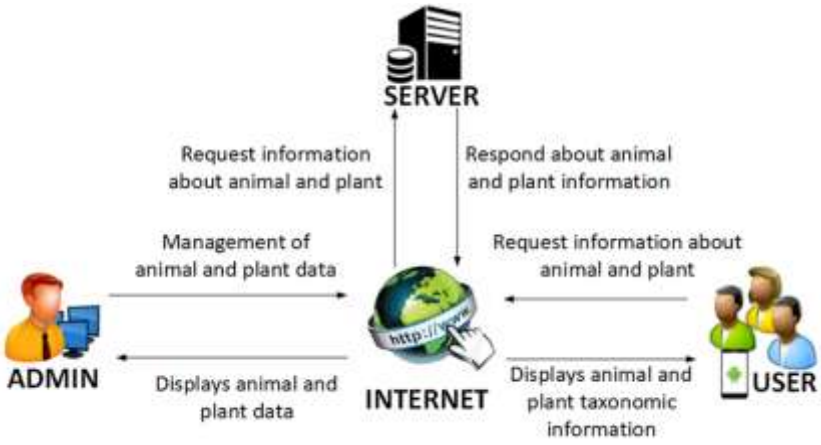

Figure. 1. System's Design in Taxonomy Application.

2.2 Use Case Diagram

Use Case diagram is a diagram that describes the functionality of a system. Figure 2 describes that the Taxonomy Application has four functionalities such as managing animal and plant data, displaying classification levels, finding information, and displaying taxon information. Admin and User have different role. Admin interacts on the web to manage the data of animals and plants that added, changed, viewed, and delete data, whereas users can interact to display classification levels, search for taxon's information, and display taxon information containing description, characteristics that is owned by the taxon, and images in the Android application.

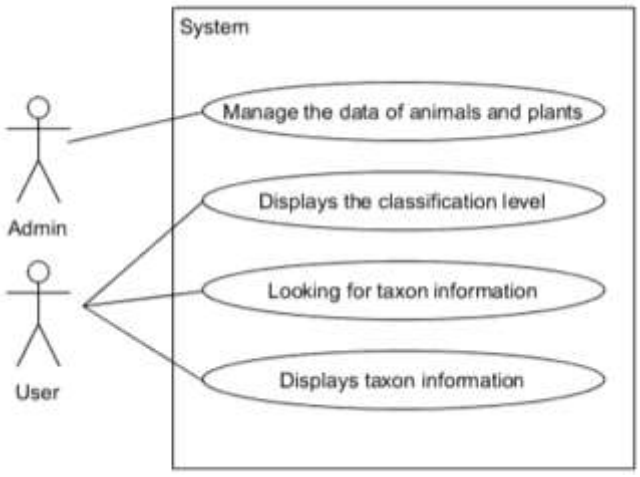

Figure. 2. *Use Case* Diagram Application.

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3. Implementation

Taxonomy Application is made by using Java Language through IDE Android Studio. Data is stored using MySQL database and web service is used as an exchange of data of animals and plants that exist on the web. The classification of plants and animals can be described in Figure 3.

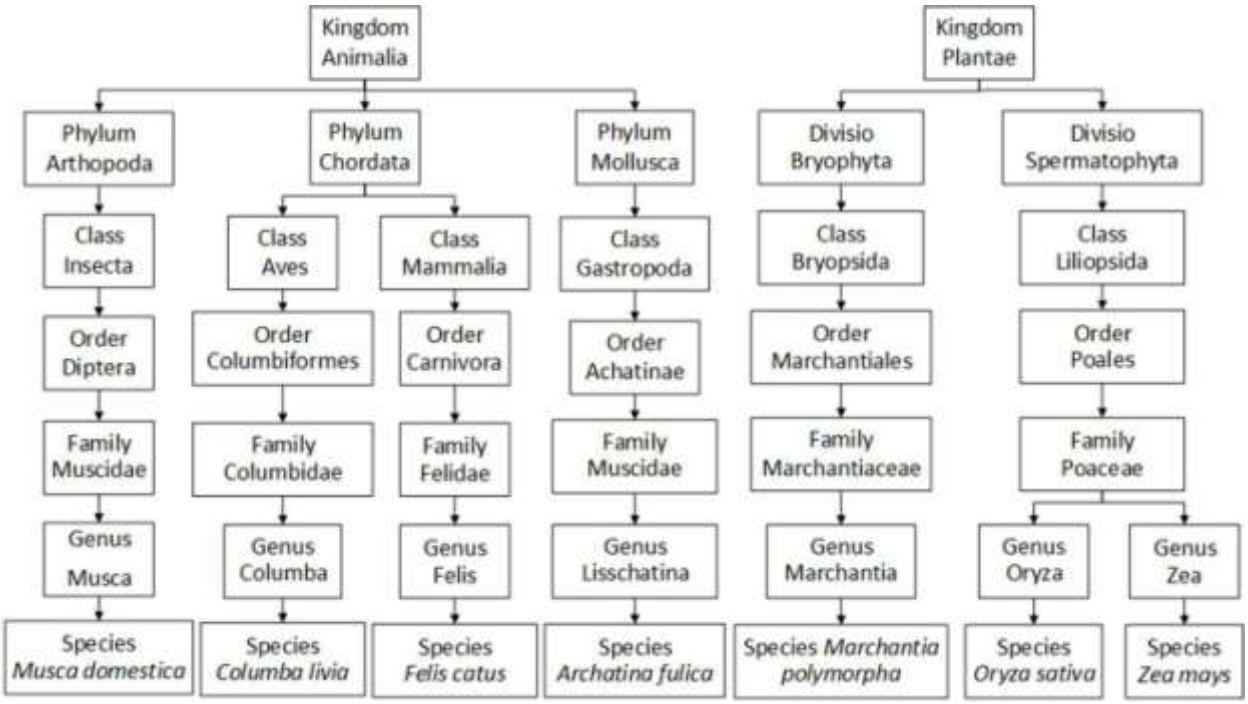

Figure. 3. Forest Tree Structure on Some Animal and Plant Classification Data.

Tree structure is a structure used to describe the hierarchical relationship among the elements that exist in a system. Classification of animals and plants has its own tree structure to form a collection of trees called forest tree. The Forest Tree structure can be used to display taxon data into a hierarchy from the highest to the lowest. The tree structure can make it easier to see the levels in a taxa.

The formation process begins with a tree root. Root in the kingdom taxonomy is displayed at the top. After root is displayed, the next call is a node. The formation of the next node is done by calling the required nodes gradually to display the taxon after root i.e. phylum to the lowest level (species). Dialing node is done gradually because there is too much data and to maintain the performance of applications. Root formation results can be seen in Figure 4 (a) and node level calling can be seen in Figure 4 (b).

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(a) (b)

Figure. 4. (a) Display Root Formation Results (b) Display Node After Root

Figure 4 (b) shows that the formation of the node after root has been done to the lowest level. The display in Figure 4 (b) makes it easy to see the taxonomic structure of the opened node and the associated taxon with other taxon. The advantage of this application with other existing applications is the implementation of Structural Forest Tree on learning media classification to display the taxonomic level of the highest level (Kingdom) to lowest (Species), making it easier to see the connection between taxa, whereas other applications [12, 13] are not displaying the taxonomic level.

For more information on taxon can be seen by long press on the screen of one of the taxon. The displayed informations are the name, description, characteristics, and level of taxon as in Figure 5.

(a) (b)

Figure. 5. (a) Display of Information Description on Species *Rana temporaria* (b) Display of characteristics information and Taxonomic Level on Species *Rana temporaria*

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Display of information in Figure 5 (a) consists the name and description of the species *Rana temporaria*. Figure 5 (b) is a continuation of Figure 5 (a) which contains the characteristics, taxon levels, and references of Species *Rana temporaria*. Species level is the only display that contains images. This study differs from previous studies [11] which feature taxonomic levels in plant species, but does not display detailed information from taxon levels, whereas in the Taxonomy Application it can display detailed information at other taxon levels when clicking available links at the taxonomic level.

In addition, information in the description, characteristics, and levels of taxon can be found quickly by searching the search feature. Taxon information search can be done based on the taxon name you want to search. Figure 6 (a) is a searching example based on a scientific name. Search can also be done by species name in Indonesian and in English. Then, the displayed results are description information, characteristics, species in that taxon, and taxon levels as shown in Figure 6 (b).

(a) (b)

Figure. 6. (a) Display of Search Feature (b) Display of Search Results

4. Results

The quality of the application can be known by testing the application to find out how far the application can solve the problem from testing and become an evaluation for the developed application. User application testing is done by quantitative method to know the satisfaction of respondent to Taxonomy Application through the assessment questionnaire. The number of respondents assessor are 50 people with 4 variable aspects of assessment, covering aspects of the suitability of the software, the user interface aspects, educational aspects, and aspects of the publication. The software conformity process aspect serves to test application errors when executed on an Android device, the user interface aspect serves to test the look of the Taxonomy Application, the educational aspect serves to test the compatibility of the taxonomic material presented in the application, and the publicity aspect for publication. Results obtained from 50 respondents with 17 questions from 4 aspects of assessment that are listed in Table 1.

Table 1. Questionnaire Results

Assessment Variables	SA	A	DA	SDA
Aspects of Conformity Software Process	61%	38%	1%	0%
Aspects of User Interface	37%	60%	3%	0%
Aspects of Education	30%	70%	0%	0%
Aspects of Publication	54%	46%	0%	0%

Results obtained from 50 respondents with 17 questions from 4 aspects of assessment that is in the Aspects of Conformity Software Process consists of 7 questions, 61% of respondents stated strongly agree, 38% of respondents stated agree, 1% of respondents stated disagree and as many as 0% of respondent stated strongly disagrees on app ratings after testing. Rate Aspect of User Interfaces consisting of three questions, 37% of the respondents strongly agree, 60% of the respondents agree, 3% of the respondents do not agree and 0% of the respondent strongly disagrees on the assessment of the application after testing.

Rate Aspect of Education consists of 6 questions, 29% of the respondents strongly agree, 71% of the respondents agree, 0% of the respondent does not agree, and 0% of the respondent strongly disagrees on the assessment of the application after testing. Rate on Aspects of Publication consisting of one question, 54% of the respondents strongly agree, 46% of the respondents agree, 0% of the respondent does not agree and 0% of the respondent strongly disagrees on the assessment of the application after testing.

The results of all tested aspects indicate the suitability of the software application process can perform well and respondents agree to the Taxonomy Application as an effective application to help students, teachers, and the general public in studying taxonomy.

5. Conclusion

The conclusion of this research is the Taxonomy Application successfully built in the form of hierarchical by applying forest tree structure on Android-based smartphone. Implementation of Forest Tree Structure in the Taxonomy Application can simplify the viewing process of the taxonomic level from highest level (Kingdom) to lowest (Species) and makes it easy to see the relation between taxon. In addition, there is a search feature to search taxonomic data more quickly and can display the information about descriptions, characteristics, taxonomic levels, and display images at the species level. The test results with quantitative methods show that the Taxonomy Application could simplify the user in classification learning becomes more effective and efficient.

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