TREE METHOD IMPLEMENTATION IN GEOGRAPHIC INFORMATION SYSTEM OF PURA KAWITAN IN BALI BASED ON ANDROID MOBILE

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Abstract

A sacred place in which Hindu teachings believe as a place to worship sacred ancestral spirits is known as Pura Kawitan – temple of Hindus origin descendants. Pura Kawitan is specific due to its bond "wit" or ancestor based on the lineage. The existence is absolute to be known by Hindus people especially in Bali. However, not all of the Hindus people in Bali know about the information of their Pura Kawitan as well as the correlation among Pura Kawitan. This lack of information limits Hindus people to recognize the ancestors from their lineage. Geospatial Geographic Information System of Pura Kawitan can be the solution of this problem. Generally, Geospatial Geographic Information System displays the location of the temple, while the Tree Method is implemented in the system in order to describe related information of the temple. This system is in Android mobile-based for easy operation set up with features such as; information of the temple, its location on Google Maps, the correlation of the temple with the Tree Method in spatial data on Google Maps which visualized using polyline, information of the ancestors and direction. The system is capable in providing information of the temple efficiently and quickly, saving the data safely and practically as it is online and can be accessed anywhere with internet connection.

Keywords: Pura Kawitan, Geographic Information System, Google Map, Mobile, Android.

1. Introduction

Hindus people worship their sacred ancestral spirits in a place known as Pura Kawitan. Pura Kawitan is specific due to its bond "wit" or ancestor based on the lineage [3]. Hindus people will feel completely Hindus after knowing the origin of their ancestors and the place to worship them. In fact, there are some of Hindus people who are unknown of the place to worship their ancestors or their Pura Kawitan. It is a common thought in the society that ancestor worship should not be done necessarily in Pura Kawitan [3]. The unknowingness and lack of information trigger Hindus people in Bali not to worship their ancestors in Pura Kawitan and often cause some oddity of life which is beyond human logic today.

The development of technology in this era can solve this problem that a system which contains information of Pura Kawitan is needed. Part of technology used to display the layout and information of one temple is Geographic Information System (GIS) as it is a technology used in mapping which provides geographical data and it was designed efficiently to gather, store, update, manipulate, analyze and display all kind of information with geographical referenced [7].

The development of Geographic Information System of Pura Kawitan uses Google Maps. 54% of Smartphone users explore the world using Google maps [8] and thus, Geographic Information System of Pura Kawitan was packaged in the form of Mobile Geographic Information System to ease its users. Tree Method also implemented in this System. Tree Method is data classification method which forms a tree or pattern with links to each data [6]. Tree Method in GIS Pura Kawitan is used in displaying correlation between each of the temples in spatial data on Google Maps in which the correlations will be visualized using polyline.

2. Geographic Information System

General definition of Geographic Information System (GIS) is an information system which integrates text data (attribute) from an

object with geographical data that linked geographically on earth (georeference). Geographic Information System (GIS) can also be used for merging, managing and analyzing the data which produces output used as references in taking decision on geographical matters [9].

Geographic Information System (GIS) uses digital information obtained from digital data production method. A common method used in producing digital data is digitalization which transforms paper map or survey layout into digital media using computer program (Computer Aided Drafting, CAD) as well as the capability used of georeferencing [9]. Normally, Geographic Information System (GIS) has two views – layout view and data view. Layout view represents visualization of data and attribute of certain dataset displayed on the map. Data view can be used for creating a smaller dataset using query tool. A layer dataset of Geographic Information System (GIS) can also be combined by dataset users to create a new layer as long as both of the dataset contains general attribute [7].

3. Mobile Geographic Information System

Mobile Geographic Information System can be defined as the capability of a mobile device in displaying geospatial data, collecting, processing and responding request from the phone users. Framework of Mobile Geographic Information System (GIS) is generally considered as an extension to Web-GIS in which a request made by phone users is processed using Internet web browser [4]. In relation of ways in accessing data and gathering information, Mobile Geographic Information System can be divided into two kind of ways; Fieldbased GIS and Location-based Services. Fieldbased GIS focuses on data collection, data validation and data update of the field such as adding a new coordinate point, changing table attribute of existing data. Location-based Services focuses on location management such as navigation, route, searching for certain location and vehicle tracking [10].

4. Google Maps

Google Maps embody a service from Google which offers current mapping technology for many needs [2]. Google Maps generally provides representation of data in every perspective like street view and route plan of a destination [5]. Google Maps has open source platform which allows the users to use this application freely by following certain regulations. Google Maps also gives freedom to the developer to develop mapping technology based on Google Maps [2]. Google has two platform options; open source platform (free) and enterprise platform (purchased). Google Maps service integrates with android device using library Google Play Service. In integrating this application, Google Maps Key is needed [5].

5. Google Maps Api

Interface generally means media communication between two systems. API is a collection of tools, protocols, and routines aimed to build and develop application for programmers. API makes the communication among different applications is possible to integrate [5]. In implementing map to other application, Google released Google Maps API introduced in 2005 [11]. Google Maps API is capable in integrating map to other application with variant features such as zoom, panning, scale for some labels [1].

6. Tree Method

Tree method is a data classification method which forms a tree or pattern with links to each data [6]. Other definition of Tree Method is one of many forms of nonlinear data structure which visualizes the connection that is hierarchical among elements shaped like a tree structure [12]. Tree structure is a method for presenting the hierarchy structure (one-to-many) graphically similar to a tree though the tree just looks like a collection of nodes from top to bottom [12]. Tree Method may as well be concluded as a collection of nodes with one specific element called root and other elements called node which divides into sets that have no connection to another (subtree). The data example of Tree Method implementation on Table 1.

Table 1. Example data for Tree Method Implementation [12]

Id	Name	ParentId
1	AB	1
2	BC	1
3	CD	1
4	DE	1
5	EF	2
6	FG	2
7	GH	3
8	HJ	3
9	JK	4
10	KL	4
11	LM	5
12	MN	5
13	NO	6
14	OP	6

Table 1 is an example of data for application of Tree Method. There are three fields in the table which consist of Id, name and ParentId. Field Id is the identity of the data, Field Name is a name of the data and Field ParentId indicates the correlation of other data with reference to Field Id which is the identity of that data.

The data will be visualized in shape of tree so the correlation between data can be determined as in Figure 1.
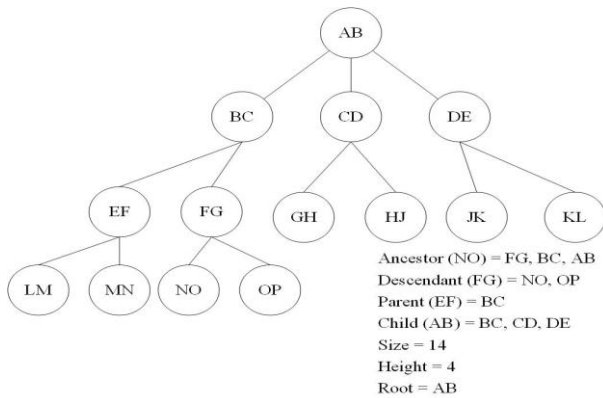

Fig 1: Tree Structure Layout [12]

Figure 1 is data from Table 1 displayed in a shape of Tree Structure. Root of the Tree Structure is data named AB who has children - data named BC, CD, DE. Height of the Tree Structure is 4 and the size is 14 because the amount of the data consist in it is 14 data. The correlation between each data has specific level of correlation depends on the node.

6. System Design

System Design contains the general illustration of system that has been created and database used in storing data in Geographic Information System of Pura Kawitan.

Fig 2: General illustration of the system

Figure 2 is general illustration when the system was running. This application uses provided map provide by Google – Google Maps. Process in displaying the map requires Internet connection. Database used in storing data in Geographic Information System of Pura Kawitan has global characteristic which has to be handled through web service. Database accessing process using web service cannot directly be done as it uses different programming language. Thus, json is needed to interpret the language. Direction process in Geographic Information System of Pura Kawitan utilizes GPS to locate the location from the smartphone.

6.1 Database Design

Database structure used in Geographic Information System of Pura Kawitan can be seen in Figure 3. There are eight tables in the database, all of the tables are interconnected in order to store the data owned by the system. The Table labeled with name; table tb_user, tb_pura_kawitan, tb_katagori_pura, tb_leluhur, tb_kepemilikan_pura, tb_desa, tb_kecamatan, tb_kabupaten. Process in displaying the correlation among Pura Kawitan in Pura Kawitan Geographic Information System uses data on the table with label tb_pura_kawitan.

Fig 3: Database Structure

7. Application Trial

Geographic Information System of Pura Kawitan has developed and needed trial for the system features. The features trial will be explained with specializing to Decisio Tree implementation with the correlation of Pura Kawitan
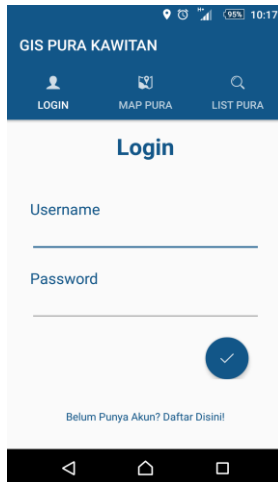
Fig 4: Login Feature

Figure 4 is a login form that must be filled by the user if they wish to enter the system. This login feature is used for entering the system and accessing other sort of features. Besides, login feature preserve the safety of the user data causes the data is forbidden to accesses by other user except the administrator. If the user does not have the account yet, she or he can do the registration as in Figure 5.

Fig 5: Register Feature

Registering process can be done by filling the form on the registering page seen in Figure 5. There are several forms such as Username, Password, First Name, Surname, Address, Latitude, Longitude and Photo that need to be filled.
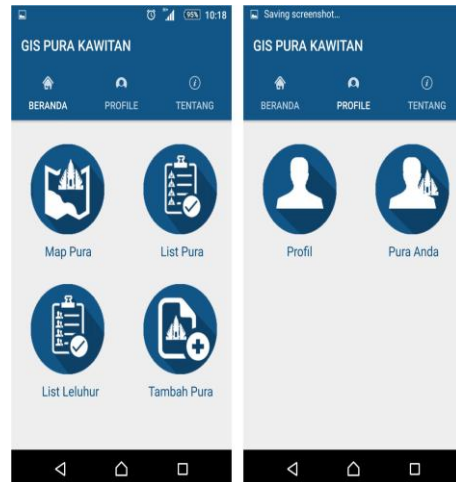

Fig 6: User Dashboard

Figure 6 is the user dashboard after finishing the login process. There are 3 menus on user dashboard including; Beranda, Profile, and Tentang. They are displayed in Menu Tab so it will be easier in choosing. There are submenus in Beranda menu such as Map Pura which presents the location of the temple, List Pura which presents data of the temple in the list form and Tambah Pura to add data of the temple. Inside the Profile menu, there are menu Profil to display the data of the login user and Pura Anda to display the temple data of the login user. Figure 7 is a feature used in adding a new data of Pura Kawitan.
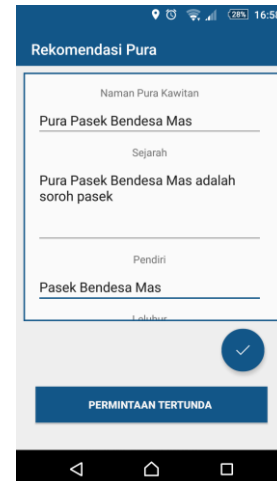

Fig 7: Tambah Pura Feature

Tambah Pura Feature is aimed to collect the data of a temple inputted by the user. The login user will input related data of the temple if the temple did not exist in the database in Geographic Information System of Pura Kawitan. After being added, the temple will be displayed on the submenu of Map Pura and List Pura as in Figure 8.
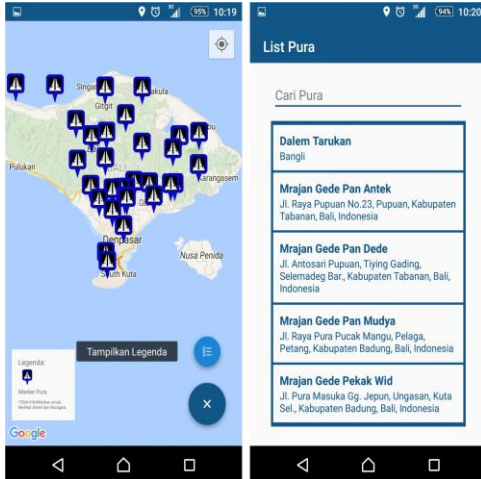
Fig 8: Map Pura and List Pura Features

Map Pura in Figure 8 is a layout of Google Maps which contains marker and data of Pura Kawitan. Even though List marker shows data of the temples, Map Pura ease the user for direct seeing the name of Pura Kawitan. Detail information of the temple can be seen by clicking on InfoWindow and an alert will pop up. Alert loads option for the temple details or Navigation as in Figure 9.
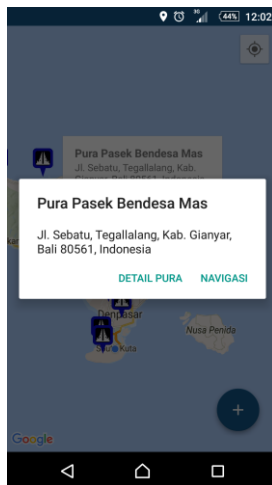

Fig 9: Alert when clicking InfoWindow

Figure 9 shows an option to see Detail Pura and Navigasi. The option Detail Pura shows selected data of Pura Kawitan in details as in Figure 10 while Navigasi option shows route to that temple using map provided by Google – Google Maps as in Figure 11.
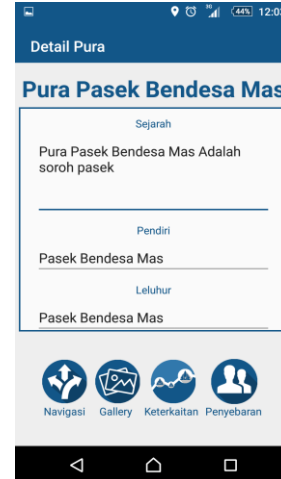
Fig 10: Details of Pura Kawitan

Figure 10 shows Pura Kawitan data in detail according to data inputted by the user. Those data can be accessed by any user registered in Geographic Information System of Pura Kawitan. There are extra features in Detail Pura such as Navigasi, the same feature as in Figure 9 and the layout has the map form which contains route leads to the location of the temple as in Figure 11. Gallery feature is a feature which shows image data of Pura Kawitan. Keterkaitan feature is the main feature of this application. This feature describes the correlation among Pura Kawitan. Besides, there is additional feature to find out the movement of Hindus people who worship at that temple.

Fig 11: Navigasi Feature

Figure 11 displays the layout for Navigasi feature which shows the route lead to the location of selected temple. The use of this feature requires support from GPS to access the user location. In addition, there are extra features in Navigasi feature as shown in Figure 12.

Fig 12: Extra Features on Navigasi
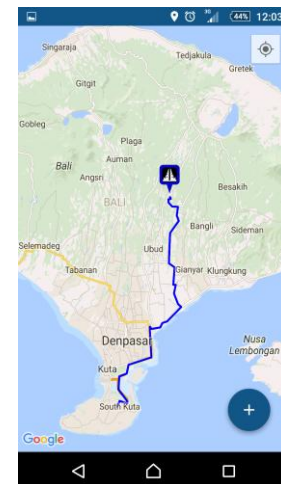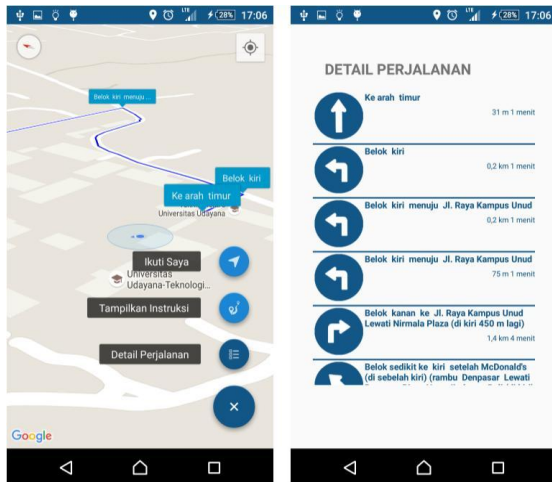
Figure 12 shows extra features with tilt 90º mode and uses compass sensor so the smartphone will be able to follow the intended direction as well as displaying instructions when maneuvering. This feature helps user by freeing them from opening other application such as Google Maps provide by Android which will require much space of RAM. Detail Perjalanan displays instructions in the form of list so it will be easier for the user to know the timing for maneuvering.

Fig 13: Gallery Feature

Figure 13 shows the Gallery feature. Data displayed in this feature are collection of images from the temple. Those images can be seen in grid view or thumbnail mode.
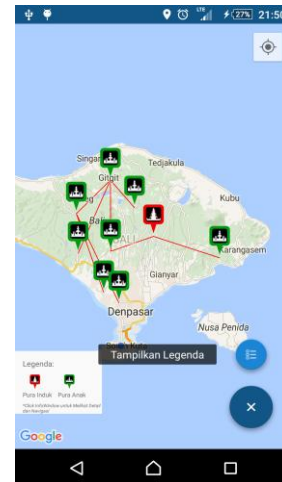
Fig 14: Keterkaitan Feature

Keterkaitan feature is the main feature in Geographic Information System of Pura Kawitan. This feature will present the correlation among the temples by implementing Tree Method and Tree Structure illustrated using polyline as in Figure 14. Red icon indicates the root of the data while the green icons are nodes related to the root which has a set of its own. However, according to the correlation rules of Pura Kawitan, a set under the nodes are also belong to the related data of the root. Thus, all of the data displayed are data of the temples which have correlation to each other. The temple data shown in Figure 14 was taken from database through web service and being interpreted into json format as in Figure 15.

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{"products":[{"id":"9","namapurakawitan":"Pura Pasek Bendesa Mas","alamat":"Jl. Sebatu, Tegallalang, Kab. Gianyar, Bali 80561, Indonesia","lat":"-8.400375435618201","lng":"115.29327392578125","parents_id":"2","child": [{"id":"10","namapurakawitan":"Pura Pasek Gelgel","alamat":"Unnamed Road, Selumbung, Manggis, Kabupaten Karangasem, Bali, Indonesia","lat":"-8.478314818393531","lng":"115.52982330322265","parents_id":"9","child":[]}, {"id":"148","namapurakawitan":"Pura Benculuk","alamat":"Jl. Batukaru No.23, Buruan, Penebel, Kabupaten Tabanan, Bali, Indonesia","lat":"-8.454442252434891","lng":"115.1408386230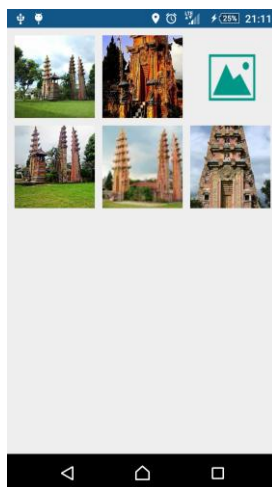4687","parents_id":"9","child": [{"id":"149","namapurakawitan":"Pura Panti Arya Tegeh Gitgit","alamat":"Jl. Raya Bedugul - Singaraja, Gitgit, Sukasada, Kabupaten Buleleng, Bali, Indonesia","lat":"-8.19640279139378","lng":"115.13946533203125","parents_id":"148","child": [{"id":"150","namapurakawitan":"Mrajan Gede Pan Dede","alamat":"Jl. Antosari Pupuan, Tiying Gading, Selemadeg Bar., Kabupaten Tabanan, Bali, Indonesia","lat":"-8.462049033677932","lng":"115.02410888671875","parents_id":"149","child":[]}, {"id":"151","namapurakawitan":"Mrajan Gede Pan Mudya","alamat":"Jl. Raya Pura Pucak Mangu, Pelaga, Petang, Kabupaten Badung, Bali, Indonesia","lat":"-8.296975492912025","lng":"115.22598266601562","parents_id":"149","child":[]}, {"id":"152","namapurakawitan":"Mrajan Gede Pan Antek","alamat":"Jl. Raya Pupuan No.23, Pupuan, Kabupaten Tabanan, Bali, Indonesia","lat":"-8.318038146593286","lng":"115.01792907714844","parents_id":"149","child": [{"id":"153","namapurakawitan":"Sanggah Tantri","alamat":"Jl. Pantai Nyanyi Banjar Pasti No.70, Pandak Gede, Kediri, Kabupaten Tabanan, Bali, Indonesia","lat":"-8.60335831090611","lng":"115.11543273925781","parents_id":"152","child":[]}, {"id":"154","namapurakawitan":"Sanggah Resa","alamat":"Gg. Nusaindah, Kerobokan Kaja, Kuta Utara, Kabupaten Badung, Bali, Indonesia","lat":"-8.641036441604837","lng":"115.169677734375","parents_id":"152","child": []}]}]}]}],"success":1}
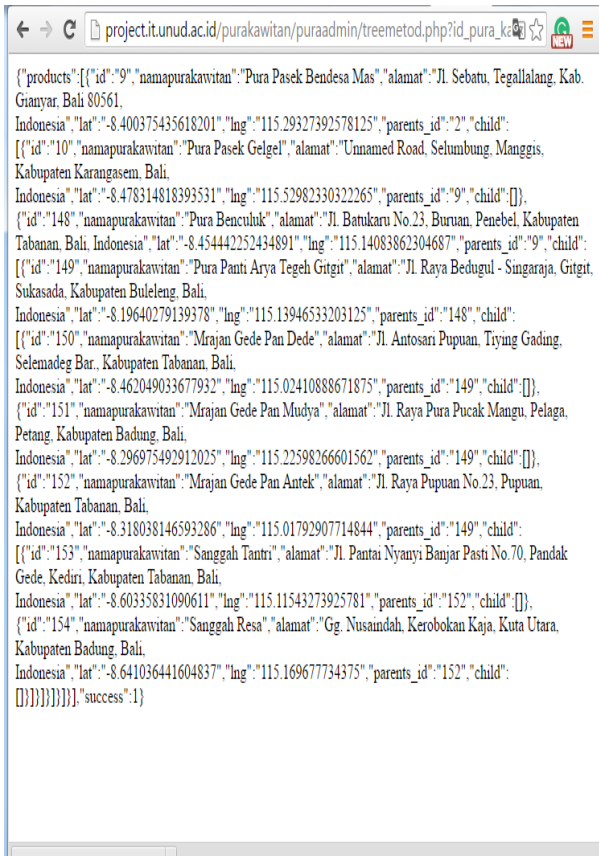
Fig 15: Data Correlation of Pura Kawitan

Data Correlation of Pura Kawitan in Figure 15 can be displayed in table form and tree structure form to illustrate a clearer description of the correlation.

Table 2. Temple Data for Tree Method Implementation

Id	Temple Name	parent	Latitude	Longitude
9	Pura Pasek Bendesa Mas	9	-8.40037543561820 1	115.29327 392578125
10	Pura Pasek Gelgel	9	-8.478314 81839353 1	115.52982 330322265
148	Pura Benculuk	9	-8.454442 25243489 1	115.14083 862304687
149	Pura Panti Arya Tegeh Gitgit	148	-8.196402 79139378	115.13946 533203125
150	Mrajan Gede Pan Dede	149	-8.462049 03367793	115.02410 888671875

			2	
151	Mrajan Gede Pan Mudya	149	-8.296975 49291202 5	115.22598 266601562
152	Mrajan Gede Pan Antek	149	-8.318038 14659328 6	115.01792 907714844
153	Sanggah Tantri	152	-8.603358 31090611	115.11543 273925781
154	Sanggah Resa	152	-8.641036 44160483 7	115.16967 7734375

Table 1 is the data of Pura Kawitan taken from database in Geographic Information System of Pura Kawitan. The data was illustrated in tree structure form so the correlation between the data can be understood as in Figure 16.
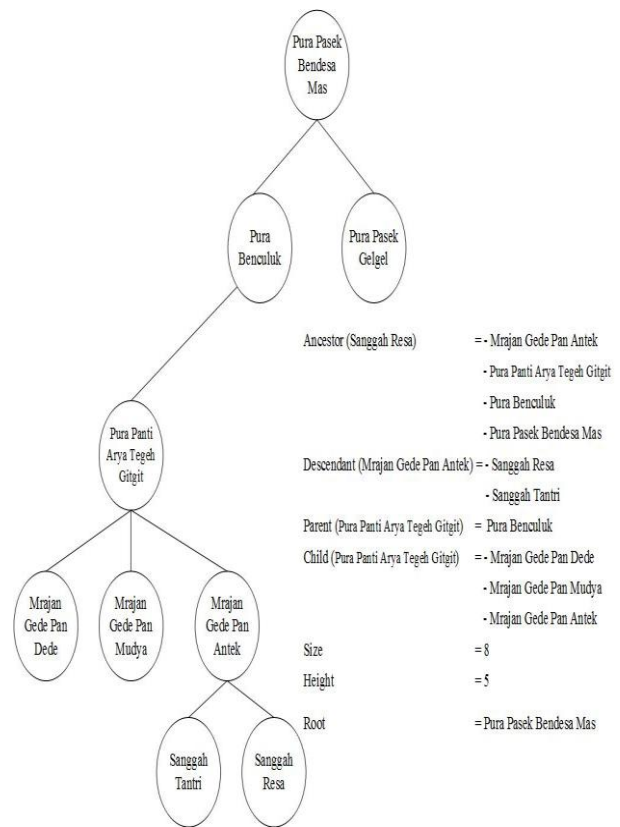

Fig 16: Tree Structur of Pura Kawitan

Figure 16 shows correlation of Pura Kawitan shown in the form of Tree Structure. Searching correlation of Pura Kawitan using the find operation owned by Tree Method. Search as displayed in the

Figure 15. System will perform a search node from the smallest id. The search performed on the node until node does not have a child again and if it happens, system will perform a search to another node which is a child of the root.

9. Time Analyses of Load Data

One factor that affecting in load data on the smartphone is the signal captured in the area when mobile data is activated. Load data of the correlation using Tree Method depends on the smartphone signal near the area and thus, it is necessary to know the required minimum signal to run this application. There are several providers in Bali that provide a good signal such as EDGE, HSDPA and LTE. Time measurement of load data uses a method derived from java in order to ensure the time measurement of load data is processed by the system itself.

Table 3. Time Analyses of Load Data

Signal/ Smartphone	LTE (second)	HSDPA (second)	EDGE (second)
Sony Xperia Z1	0.26200-0.34700	0.31500-1.73100	1.75200-4.16600
Samsung Galaxy Duos	-	0.37400-143500	1.80800-4.88800
Samsung Galaxy Note 5	0.21400-0.32700	0.29700-1.55600	1.64500-3.64600
Xiomi Redmi Note 3G	-	0.31200-1.64500	1.73200-4.36700
Asus Zenfone 2	0.278.00-0.48900	0.380000-1.75800	1.74200-4.30500

Time measurement of load data on the application uses method system.currentTimeMillis(). The method is able to display time needed for the load data process on the application. Table 3 shows the result of load data from 5 smartphones. As seen from the above table, it can be concluded that using EDGE signal is enough to load the correlation data of Pura Kawitan using Tree Method.

10. Conclusion

Tree Method can be implemented in Geographic Information system of Pura Kawitan in Bali with Android Mobile-Based to discover the correlation between Kawitan temples. Besides, Geographic Information system of Pura Kawitan in Bali with Android Mobile-Based also provides information of the location of the temples on Google Maps and gives related information to the temples. Due to its online access and android mobile-based, it is easy to use this application after connecting the smartphone to the Internet. With only EDGE signal in Indonesia especially in Bali, the user can access it.

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