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A REUSABLE BALINESE CALENDAR ENGINE

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ABSTRACT

Most of the Balinese digital calendar development begins with creating an engine, which becomes an inefficient development process. In this study, a reusable engine of the Balinese calendar was designed. This study used DSRM methodology to identify problems and produce an engine as the solution. The engine was a combination of Python and PLSQL, which makes it flexible to be customized and embedded. The engine has several algorithms to calculate Balinese calendars attributes (*wuku*, *dewa*, *wewaran* from *ekawara* to *dasawara*, *ingkel, jejepan, lintang, watek, urip* or *neptu, ekajala rsi, zodiak, pengalantaka, sasih* and year of Saka Calendar, full moon or new moon) and adjusted with the Saka and Pawukon calendar system. The engine consists of a web service that served as data parser and a database to store the attributes. Results of the experiment showed that the engine was able to generate appropriate Balinese calendar attributes of one day up to one-month or one-year Gregorian calendar, compared to the other existing Balinese digital calendar.

Keywords: *Balinese Calendar, Engine, Python, Pawukon, Saka*

1. INTRODUCTION

The digital age is a chance for converting any analog stuff into a digital application, include Balinese traditional calendar. The lunisolar calendar that used since a long time ago by Balinese-Hindu people in Bali - Indonesia, now has many digital forms like in www.kalenderbali.org[1] or a desktop application named BalaBali [2].

Unlike Gregorian calendar, a Balinese calendar has a unique dating system because it is consist of Saka and Pawukon calendars which run simultaneously [3]. It makes every single day have attributes which indicating a good time for several activities and religious ceremony [4] that regularly come repeatedly [5].

There are several studies about creating digital versions of Balinese calendar like in [6] and [7]. The researchers were built a set algorithm first before designing calendar. Building an engine from the beginning is inefficient and it would be worse if there are any inappropriate calculations. A standard engine for digital calendar development is needed to avoid mistakes in calculation.

In this study, an engine was designed which provide an appropriate calculation of Balinese calendar attributes. The engine built in python because python offers a flexibility [8] when implemented in many system. The engine would be flexible to embedded and customized.

The rest of this paper is presented as follows. Section 3 presents literature review about some attributes in Balinese calendar. Section 4 loaded by explanation of methodology used in this study. Experiment and analysis of the engine are presented in section 5. The result of analysis is concluded in section 6.

2. PREVIOUS RESEARCH

Pradnyani in 2014 developed an Android-based Balinese calendar. It was started by designing the algorithm to calculate Balinese calendar's attributes like wariga, purnama, tilem and sasih, etc, as in Balinese Saka calendar [6].

In the same year, Suwintana and Prihatini break-down their study about developing a Balinese calendar that can display rahinan, wewaran, panglong and ingkel of each day. The algorithm designed by their own used as the engine for calculating every attributes that appeared in the data flow diagrams of the system [7].

The mentioned previous studies show that the development of the Balinese calendar begins with creating an engine before integrating it into the calendar's design. It was not efficient and tend to have any inconsistent calculation. In this study, an engine was developed to address the issue. The engine was supported by Python language, therefore it was easy to embed into many environments.

3. LITERATURE REVIEW

There are two calendars used in Bali, the Pawukon and Saka calendars. Both these calendars run simultaneously, along with the Gregorian Calendar. Each calendar has different attributes and number of the days in a year. This section includes explanation about those two calendars, as well as attributes of either.

3.1 Pawukon Calendar System

Pawukon calendar is an arithmetic calendar system. One year of Pawukon calendar consists of 210 days [9]. There are 30 *wuku* (week) in a year, which every week has its own name. The name of *wuku* in a year listed in Table 1.

Table 1. List of 30 Wuku

No	Name of *Wuku*	No	Name of *Wuku*
1	*Sinta*	16	*Pahang*
2	*Landep*	17	*Krulut*
3	*Ukir*	18	*Mrakih*
4	*Kulantir*	19	*Tambir*
5	*Tolu*	20	*Medangkungan*
6	*Gumbreg*	21	*Matal*
7	*Wariga*	22	*Uye*
8	*Warigadean*	23	*Manail*
9	*Julungwangi*	24	*Prangbakat*
10	*Sungsang*	25	*Bala*
11	*Dungulan*	26	*Ugu*
12	*Kuningan*	27	*Wayang*
13	*Langkir*	28	*Kulawu*
14	*Medangsia*	29	*Dukut*
15	*Pujut*	30	*Watugunung*

The word *wuku* literally means a slice [10], since it is a week-division in a year. The cycle of pawukon calendar start from *Sinta wuku*, then ended with *Watugunung wuku*. When reached *Watugunung wuku*, Hindu's people in Bali usually celebrate Saraswati as a gratitution of knowledge and science.

3.2 Balinese-Saka Calendar System

Besides Pawukon system, Hindu-Balinese also had another calendar system called Saka or Caka. Saka calendar system based on the moon phases. It length approximately the same as the Gregorian calendar [11].

One Saka year consists of 12 months called *sasih*, which is correspond to the number of months in the Gregorian calendar. The 12 *sasih* in Balinese Saka calendar are shown in Table 2.

Table 2. Sasih *in Balinese Saka Calendar*

No	Name of *Sasih*	No	Name of *Sasih*
1	*Kasa*	7	*Kapitu*
2	*Karo*	8	*Kaulu*
3	*Ketiga*	9	*Kesanga*
4	*Kapat*	10	*Kedasa*
5	*Kalima*	11	*Jyesta*
6	*Kanem*	12	*Sadha*

Besides in the Table 2, each of *sasih* also has another naming system. The other name of each *sasih* are shown in Table 3.

Table 3. Another name of Sasih

No	Name of *Sasih*	Another Name
1	*Kasa*	*Srawama*
2	*Karo*	*Bhadrawada*
3	*Ketiga*	*Amuji*
4	*Kapat*	*Kartika*
5	*Kalima*	*Marggasira*
6	*Kanem*	*Pomya*
7	*Kapitu*	*Magha*
8	*Kaulu*	*Phalguna*
9	*Kesanga*	*Caitra*
10	*Kedasa*	*Waisaka*
11	*Jyesta*	*Jyestha*
12	*Sadha*	*Asadha*

Each month in the Balinese Saka Calendar consist of 30 days. In a month, there are two important celebration of moon phases, the full moon (*Purnama*) and new moon (*Tilem*). The beginning phase until a full moon called *penanggal*. After a full moon to 15 days while waiting for a new moon called *panglong*.

Every beginning of the Saka year (*Isakawarsa*) is celebrated as Nyepi. This celebration is known as the day of silence, where Balinese people live in silence and turn off the lights for one day [12]. Nyepi always falls at Kedasa *sasih*.

3.3 *Wewaran*

Wewaran is a system for determining the number of days in a week. On the other hand, *wewaran* is a system for grouping days. Unlike the Gregorian calendar which has fixed 7 days in a week, Balinese

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calendar system defines several divisions of the number of days in a week. The division called *wewaran* [13]. For example, the three-days week *triwara* consist of *pasah*, *beteng* and *kajeng*, scheduled as the day for traditional markets in the villages. In the past, traditional market in Bali shifts from one village to another. If the market day felt on *Pasah*, it means a market's crowded situation on that day may affect the traffic jam on the road near the market

There are 10 groups of *wewaran*, start from 1 (*ekawara*) to 10 (*dasawara*) days in a week. Each of days in the group distinguished by its name, nature, condition, location, and *urip*. Table 4 shows the *wewaran* system in Balinese calendar.

Table 4. List of Wewaran *and Its* Urip

No	*Wewaran*	Name of the day	Number of the *urip*
1	Ekawara	1. Luang	1
2	Dwiwara	1. Menga 2. Pepet	4 5
3	Triwara	1. Pasah 2. Beteng 3. Kajeng	9 4 7
4	Caturwara	1. Sri 2. Laba 3. Jaya 4. Mandala	6 5 1 8
5	Pancawara	1. Umanis 2. Paing 3. Pon 4. Wage 5. Kliwon	5 9 7 4 8
6	Sadwara	1. Tungleh 2. Aryang 3. Urukung 4. Paniron 5. Was 6. Maulu	7 6 5 8 9 3
7	Saptawara	1. Redite 2. Soma 3. Anggara 4. Buda 5. Wraspati 6. Sukra 7. Saniscara	5 5 4 7 8 6 9
8	Astawara	1. Sri 2. Indra 3. Guru 4. Yama 5. Ludra 6. Brahma 7. Kala 8. Uma	6 5 8 9 3 7 1 4
9	Sangawara	1. Dangu 2. Jangur 3. Gigis 4. Nohan 5. Ogan 6. Erangan 7. Urungan 8. Tulus 9. Dadi	5 8 9 3 7 4 6 8
10	Dasawara	1. Pandita 2. Pati 3. Suka 4. Duka 5. Sri 6. Manuh 7. Manusa 8. Raja 9. Dewa 10. Raksasa	5 7 10 4 6 2 3 8 9 1

Table 3 showed that attributes have it own *urip*. *Urip* or *neptu* is a lived rhythm. In Balinese ritual ceremonies, the existence of *urip* in a day symbolized by adding *uang kepeng* or chinese *kepeng* (*pis bolong* in Balinese language), a traditional money which is deals in many aspect of Balinese traditional ceremonies [14]. *Uang kepeng's* coin known as traditional money with a hole in the middle.

3.4 *Dewasa*

Dewasa is a Balinese term for indicating characteristics of a day which appraise from attributes in Balinese calendar (*wuku, sasih, urip, wewaran, etc*). *Dewasa ayu* indicates a propitious or good time to do particular activities. There is also *dewasa ala* which is a suggestion of unpropitious or bad day, therefore it should be avoided for several activities and ritual ceremonies. Many activities and ritual ceremonies are celebrated depending on the *dewasa ayu* and *dewasa ala*, like agriculture and plantation, farm and fishery, equipment and weapon, construction, various businesses, and it also used in all the religious ceremonies. Some sacred ritual which was performed at certain times are based on *dewasa ayu* calculation [15].

Dewasa in a day is indicated by some attributes in Balinese calendar, like *wuku, sasih, wewaran, urip, etc*. Every attribute or combination of them has a characteristic. The characteristic would be a determiner whether the attribute(s) has a good or bad relation to several activities [16]. For example, Table 5 shows the characteristics of the *wewaran* attributes.

Table 5. Characteristic of Wewaran

Wewaran	**Name of the day**	**Characteristic(s)**
Ekawara	a. Luang	sole/empty
Dwiwara	a. Menga	open/light
	b. Pepet	closed/dark
Triwara	a. Pasah	apart
	b. Beteng	wealthy
	c. Kajeng	sharp
Caturwara	a. Sri	wealthy
	b. Laba	succeeded
	c. Jaya	superior
	d. Mandala	prosperity surround
Pancawara	a. Umanis	flavors
	b. Paing	creation
	c. Pon	mind
	d. Wage	good
	e. Kliwon	*budhi*
Sadwara	a. Tungleh	not eternal
	b. Aryang	thin
	c. Urukung	extinct
	d. Paniron	fat
	e. Was	strong
	f. Maulu	breeding
Saptawara	a. Redite	Soca: growing plots
	b. Soma	Bungkah: growing tubers
	c. Anggara	Godhong: growing vegetables and leaves
	d. Buda	Flower: growing flowers
	e. Wraspati	Wija: growing crops that produce seeds
	f. Sukra	Woh: growing fruits
	g. Saniscara	Pagers: building a fence
Astawara	a. Sri	prosperity (organizer)
	b. Indra	beautiful (mover)
	c. Guru	guidance (guides)
	d. Yama	fair (judicial)
	e. Ludra	smelting
	f. Brahma	creator
	g. Kala	value
	h. Uma	keeper (researcher)
Sangawara	a. Dangu	between light and darkness
	b. Jangur	between continue and cancel
	c. Gigis	simple
	d. Nohan	happy
	e. Ogan	confused
	f. Erangan	revenge
	g. Urungan	cancel
	h. Tulus	*langsu*
	i. Dadi	Continue
Dasawara	a. Pandita	happy / cheerful
	b. Pati	easy offense, soul of art
	c. Suka	femininity, subtle
	d. Duka	always obedient, according to
	e. Sri	have a social feel
	f. Manuh	the soul of leadership
	g. Manusa	spirituality
	h. Raja	hard soul, not through consideration
	i. Dewa	happy / cheerful
	j. Raksasa	easy offense, soul of art

The process of analyzing characteristics of *wuku*, sasih, *wewaran*, or the other attributes to determining *dewasa* exists in a science called *wariga*, an ancient Balinese science [17]. Several ancient palm-leaf manuscripts (*lontar*) which giving explanation about wariga include *Sundari Gading*, *Sundari Cemeng*, *Panglantaka*, and calculation of *Nampi Sasih* [18].

4. METHODOLOGY

This study used Design Science Research Methodology (DSRM), a research methodology based on problem and developing an application as the solution [19]. Figure 1 shows the 6 phase of DSRM methodology.

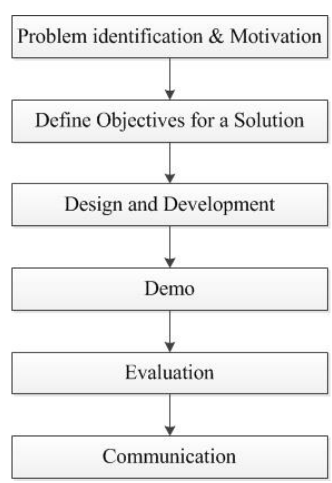

Figure 1. Phases in DSRM Methodology

This study starts with problem identification and motivation phase, which clearly defined a specific research problem then justify the value of the solution. In this study, the research problem was how to present the digital version of Balinese calendar which has a specific calculation.

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The research problem would be followed by defining objectives for the solution. The objective in this study was developing a desktop-application for digitalizing Balinese calendar.

The determined solution would be actualized since the third phase until the last phase of DSRM methodology. In the third phase, functionalities of the design object was determined and creating the actual artifact. The whole application then demonstrate in the Demonstration phase, to measure the application's usage in solving the research problem. Demonstration result would be a material for evaluation, as the next phase.

The last phase in the methodology is communication. The research problem and its importance, artifact, utility, novelty, effectiveness, and the other relevant audiences of the research would be communicated. Journal publication is one of the way for communicating the research result [20].

5. RESULT AND ANALYSIS

In this study, a python engine which provides attributes of Balinese calendar was developed. There was a database for storing attributes. The engine processed data from user input. With sets of algorithms, the engine would process the input to provide the right attribute of a single day, month, or a year. However, the engine would not be optimal in showing date's attributes before the reference date, i.e. January, 1st 1899.

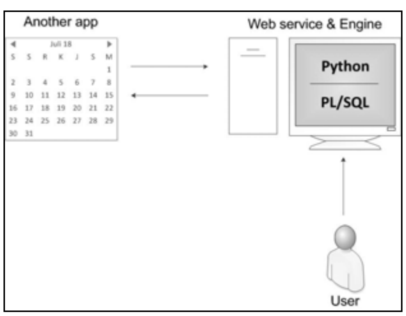

Figure 2. Engine Overview

Figure 2 shows the overview of the engine. The web service which is accessed by the user was coded in Python and PL/SQL. Web service was served as data parser, therefore it would be able to reuse for programming another Balinese calendar application.

The developed engine in this study used some algorithms for calculating Balinese calendar attributes. Here presents the algorithms for calculating *wuku, wewaran*, full and new moon.

5.1 Algorithm for Attributes

Attributes which calculated by the engine are *wuku*, *dewa*, *wewaran* (*ekawara* to *dasawara*), *ingkel, jejepan, lintang, watek, urip* or *neptu, ekajala rsi, zodiak, pengalantaka, sasih* and year of Saka Calendar, *purnama* (full moon) or *tilem* (new moon) at the day. The attributes were able to calculated as they have an algorithmic pattern. Each attribute has a different pattern, therefore it needs many algorithms for every single attribute. For example, calculation of *ekawara* and *dwiwara* are different, although they went to the same group, i.e. *wewaran*. Some algorithms for calculating the attributes are presented here.

5.1.1. Calculating *wuku*

In Pawukon Calendar system, there are 30 *wuku* as the division of a year. Every *wuku* aged for 7 days, then one year of Pawukon Calendar consists of 210 days. The *wuku* starts of Sinta and ended at Watugunung. Here is the algorithm for calculating *wuku* of each day.

```
set reference date (refDate);
get input date (inDate);
dateDiff <- abs(inDate – refDate)
timeDiff <- round(dateDiff/7)
wukuNo <- timeDiff%30
if (wukuNo == 0) then wukuNo <- 30
```

Calculation of *wuku* using absolute of input date from the user, and reference date which set on January 1st, 1899. The result of abs then divided by 7 and rounded. If the result is 0, then the *wuku* is Watugunung.

5.1.2. Calculating *wewaran*

There are 10 kinds of *wewaran* for grouping days in a week. All the type of *wewaran* consist of the different number of the days, therefore each of *wewaran* has a different calculation. For *ekawara*, becaue it is contained only 1 number of the day, the other day would not have attribute of *ekawara*. For another *wewaran* from *dwiwara* to *dasawara*, every day should have those attribute because it consists of more than 2 number.

```
A= uripPancawara
B= uripSaptawara
ekawara <- A + B
if (ekawara % 2 == 0)
  ekawara = menala
else
  ekawara = 0
```

Calculation of *ekawara* using two items, *urip pancawara* and *urip saptawara*. The two *urip*'s

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then divided by 2. If the results is 0, then the day was having *ekawara*. The other result indicating that the day did not having *ekawara's* attribute.

Calculation of *dwiwara* is slightly different from *ekawara*. The calculation still used *urip pancawara* and *urip saptawara*, but when the condition of modulo is not resulted in 0, then the *dwiwara's* attributes comes *Menga*.

Attributes *triwara* to *dasawara* has a different calculation. When ekawara and dwiwara used *urip pancarawa* and *urip saptawara*, calculating attributes from *triwara* to *dasawara* using the number of *wuku* and number of *saptawara*. Here the example of calculation of *triwara*.

```
A= noWuku
B= noSaptawara
triwara <- (A*7) + B
if (triwara % 3 == 0)
  triwara = Kajeng
else if (caturwara % 3 == 1)
  triwara = Pasah
else
  triwara = Beteng
```

The number of *wuku* (`noWuku`) in the algorithm refers to the sequence number of *wuku* when it was sorted from Sinta to Watugunung. If the *wuku* is Sinta, then the number of *wuku* becomes 1, and when the number 30 would go for Watugunung. The condition is the same for the number of *saptawara* (`noSaptawara`).

5.1.3. Calculating *purnama/tilem*

Full moon (*purnama*) and new moon (*tilem*) have a 15 day time difference. *Purnama* counted 15 days since the beginning of a *Sasih*, while *tilem* counted 15 days after full moon was felt. The engine provided information of a full moon / new moon when happens during a day. The algorithm for calculating when a full moon or new moon is:

```
Set date
checkSasih()
checkPenanggal()
checkPanglong()
if penanggal <- fullMoon
else newMoon
```

The function `checkSasih()`, `checkPenanggal()` and `checkPanglong()` mean the engine called a function for checking the *sasih* first, then checking the existence of *penanggal* or *panglong* attribute on that day. If the day having a *penanggal*, then it would be the day for a full moon. The new moon is indicated by the existence of a *panglong*.

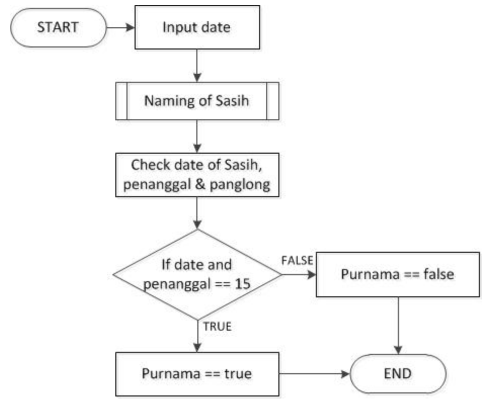

Figure 3. Flowchart of Full Moon Indication

Figure 3 shows a flowchart for observing if a full moon falls on a specific day, which determined by the existence of attribute *penanggal*.

5.2 The System and Analysis

The engine was developed in Python. The used of Python as the programming language would give a flexibility in further development because Python has a flexibility when embedded in a website or mobile application. Development of the engine supported by using some software which listed as follows:

a. XAMPP 7.1.9
b. Python 2.7.12
c. JetBrains ToolBox 1.6.2914
d. PyCharm Professional 2017.2.4
e. DataGrip 2017.2.3

The engine was tested through a console. The user was allowed to give an input date, then it processed in the engine. The input processed through a sort of algorithm to produce the attributes. List of attributes was stored in the database, therefore the result of calculation would be matched and delivered to the user. The user would be delivered output in the console. Figure 4 showed the input process in the console.

Figure 4. The Engine When Tested on Console

The instruction in console given in Bahasa Indonesia. The console provides 3 input lines for entering the start-date, start-month, and start-year of calculation that user want to do. After start-date,

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the next line provided for giving the end date, month and year of calculation. These type of input allowed the user to adjust the engine for calculating the attributes of a day, a month, and also a year.

If the start and end date are the same, this engine would calculate attributes of a single day. The given input is November 11, 2017. With the algorithms, the engine would calculate the Balinese calendar attribute of November 1th, 2017, and deliver the result to the user. The result of calculation shown in Figure 5.

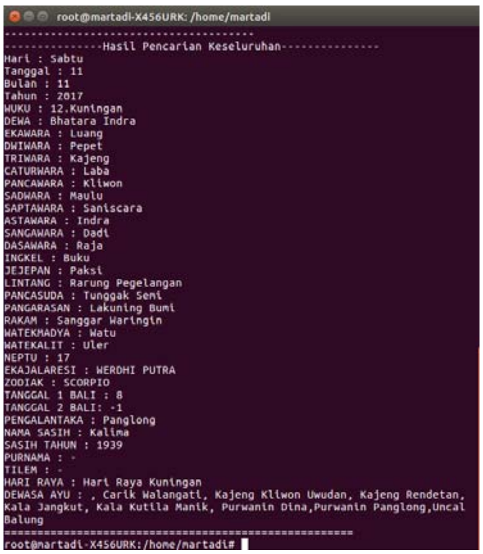

Figure 5. The Result of Calculation

Figure 5 shows the output of the engine. The output attributes are *wuku, dewa, wewaran (ekawara* to *dasawara), ingkel, jejepan, lintang, pancasuda, pangarasan, rakam, watekmadya, watekalit, urip/neptu, ekajalaresi, zodiak, pengalantaka*, name of sasih, Saka year, *purnama/tilem*, Hindu's ceremonies and *dewasa ayu* on the day. The number of output attributes is 32 Balinese calendar's attributes.

To ensure the attribute's accuracy, the output of the engine would be compared with an existing Balinese calendar. This comparison process uses BalaBali calendar, as a digital Balinese calendar which is already figured the right Balinese calendar attributes. Figure 6, which attached at the end of this article, showed BalaBali's attribute on November 11, 2017.

Attributes in Figure 6 exactly match with the attributes resulted by the engine. It shows the engine has provided the appropriate attributes for a single date.

The testing process continued for one month in the Gregorian calendar. The start date entered into the system is November 1, 2017, and end date on November 30, 2017. Output attributes of the engine showed in Figure 7 which placed on page 9 of this article.

The attributes would be matched again with BalaBali Balinese calendar. Figure 8 shown the Balinese calendar's attributes of BalaBali calendar. Figure 8 is attached on page 10 of this article.

The comparison between attributes which resulted from the engine and attributes in BalaBali calendar was exactly matched. This means calculation process in the engine produces the appropriate attributes.

The last comparison is matching *purnama*, *tilem* and Nyepi ceremonies from 1980 to 2020 of Gregorian calendars to the ceremonies from the calculation of the engine. The comparison is shown in Table 6 attached at the end of this article. Results in Table 6 shows that the date of *purnama, tilem*, and Nyepi in the engine are exactly the same as the date at BalaBali.

The experiment showed that the developed engine calculated Balinese calendar's attributes accurately, therefore it was already to embed. Figure 9 shows one of development of the engine which embedded into a website service www.infowariga.com as a widget.

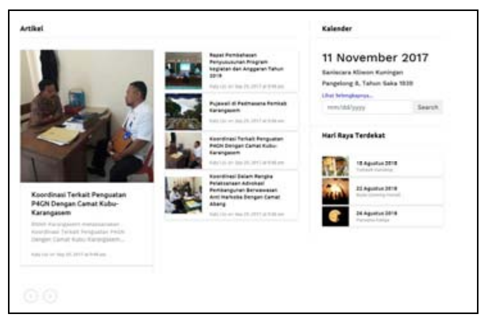

Figure 9. The Reusable Engine Embedded in a Website

Digital Balinese calendar really useful for Balinese-Hindu people who wants to trace their date of birth. Balinese people who were born in the early 20th century usually did not record their date-month-year birthday. They only remember their *otonan*, a Balinese "birthday" based on Pawukon calendar [21] which be repeated every 210 days [22] and estimated year of birth. With giving remembered attributes as the input, the calendar would help in tracing one's date of birth.

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6. CONCLUSION

A reusable Balinese calendar engine had developed in this study. The engine provides algorithms for calculating Pawukon calendar and Balinese Saka calendar's attributes. The attributes include *wuku, dewa, wewaran (ekawara* to *dasawara), ingkel, jejepan, lintang* (latitude), *pancasuda, pangarasan, rakam, watekmadya, watekalit, urip/neptu, ekajalaresi*, zodiac, *pengalantaka,* name of *Sasih*, *Saka* year, *purnama* / *tilem*, Hindu's ceremonies and *dewasa ayu* (propitious day) on a single day, one month, or one year. According to the comparison result, the attributes generated by the engine were exactly matched to the existing BalaBali calendar, therefore the resulted attributes were appropriate. However, this engine would not be optimal to generate attributes before the referenced date, i.e. before January 1st, 1899. In the future, the engine could expand the reference date. Hopefully, the output of this work would be a standard engine for digital Balinese calendar.

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Figure 6. Balinese Calendar Attributes in BalaBali Calendar on Saturday, November 11th, 2017

	id_kalender	hari	tanggal	tgl_masehi	bln_masehi	thn_masehi	nampih	tgl_1_bali	tgl_2_bali	bln_bali	thn_bali	pengelanta
1	1	Rabu	2017-11-01	1	11	2017	Normal	13	-1	Kalima	1939	Penanggal
2	2	Kamis	2017-11-02	2	11	2017	Normal	14	-1	Kalima	1939	Penanggal
3	3	Jumat	2017-11-03	3	11	2017	Normal	15	-1	Kalima	1939	Penanggal
4	4	Sabtu	2017-11-04	4	11	2017	Normal	1	-1	Kalima	1939	Panglong
5	5	Minggu	2017-11-05	5	11	2017	Normal	2	-1	Kalima	1939	Panglong
6	6	Senin	2017-11-06	6	11	2017	Normal	3	-1	Kalima	1939	Panglong
7	7	Selasa	2017-11-07	7	11	2017	Normal	4	-1	Kalima	1939	Panglong
8	8	Rabu	2017-11-08	8	11	2017	Normal	5	-1	Kalima	1939	Panglong
9	9	Kamis	2017-11-09	9	11	2017	Normal	6	-1	Kalima	1939	Panglong
10	10	Jumat	2017-11-10	10	11	2017	Normal	7	-1	Kalima	1939	Panglong
11	11	Sabtu	2017-11-11	11	11	2017	Normal	8	-1	Kalima	1939	Panglong
12	12	Minggu	2017-11-12	12	11	2017	Normal	9	-1	Kalima	1939	Panglong
13	13	Senin	2017-11-13	13	11	2017	Normal	10	-1	Kalima	1939	Panglong
14	14	Selasa	2017-11-14	14	11	2017	Normal	11	-1	Kalima	1939	Panglong
15	15	Rabu	2017-11-15	15	11	2017	Normal	12	-1	Kalima	1939	Panglong
16	16	Kamis	2017-11-16	16	11	2017	Normal	13	-1	Kalima	1939	Panglong
17	17	Jumat	2017-11-17	17	11	2017	Normal	14	-1	Kalima	1939	Panglong
18	18	Sabtu	2017-11-18	18	11	2017	Normal	15	-1	Kalima	1939	Panglong
19	19	Minggu	2017-11-19	19	11	2017	Normal	1	-1	Kanem	1939	Penanggal
20	20	Senin	2017-11-20	20	11	2017	Normal	2	-1	Kanem	1939	Penanggal
21	21	Selasa	2017-11-21	21	11	2017	Normal	3	-1	Kanem	1939	Penanggal
22	22	Rabu	2017-11-22	22	11	2017	Normal	4	-1	Kanem	1939	Penanggal
23	23	Kamis	2017-11-23	23	11	2017	Normal	5	-1	Kanem	1939	Penanggal
24	24	Jumat	2017-11-24	24	11	2017	Normal	6	-1	Kanem	1939	Penanggal
25	25	Sabtu	2017-11-25	25	11	2017	Normal	7	-1	Kanem	1939	Penanggal
26	26	Minggu	2017-11-26	26	11	2017	Normal	8	-1	Kanem	1939	Penanggal
27	27	Senin	2017-11-27	27	11	2017	Normal	9	-1	Kanem	1939	Penanggal
28	28	Selasa	2017-11-28	28	11	2017	Normal	10	-1	Kanem	1939	Penanggal
29	29	Rabu	2017-11-29	29	11	2017	Normal	11	-1	Kanem	1939	Penanggal
30	30	Kamis	2017-11-30	30	11	2017	Normal	12	-1	Kanem	1939	Penanggal

Figure 7. Output of Engine Attributes for One Month

Figure 8. One-Month Balinese Calendar Attributes in BalaBali Calendar

Table 6. Full Matched of Purnama, Tilem and Nyepi from 2017th

No	Full Match of Purnama, Tilem and Nyepi Celebration from 2017		Python Engine	BalaBali Calendar
1	Purnama Kapitu 1938 Saka	: Wraspati Paing Dukut	√	√
2	Tilem Kapitu 1938 Saka	: Sukra Paing Sinta	√	√
3	Purnama Kawolu 1938 Saka	: Saniscara Paing Ukir	√	√
4	Tilem Kawplu 1938 Saka	: Saniscara Umanis Tolu	√	√
5	Purnama Kasanga 1938 Saka	: Radite Umanis Warigadean	√	√
6	Tilem Kasanga 1938 Saka	: Soma Umanis Sungsang	√	√
7	Nyepi Tahun Baru 1939 Saka	: Anggara Paing Sungsang	√	√
8	Purnaina Kadasa 1939 Saka	: Anggara Umanis Kuningan	√	√
9	Tilem Kadasa 1939 Saka	: Anggara Kliwon Medangsia	√	√
10	Purnama Jiyestha 1939 Saka	: Buda Kliwon Pahang	√	√
11	Tilem Jiyestha 1939 Saka	: Wraspati Kliwon Merakih	√	√
12	Purnama Sadha 1939 Saka	: Sukra Kliwon Medangkungan	√	√
13	Tilem Sadha 1939 Saka	: Sukra Wage Uye	√	√
14	Purnama Kasa 1939 Saka	: Saniscara Wage Perangbakat	√	√
15	Tilem Rasa 1939 Saka	: Radite Wage Wayang	√	√
16	Purnama Karo 1939 Saka	: Soma Wage Dukut	√	√
17	Tilem Karo 15/1 1939 Saka	: Anggara Wage Sinta	√	√
18	Purnama Katiga 1939 Saka	: Anggara Pon Ukir	√	√
19	Tilem Katiga 1939 Saka	: Buda Pon Tolu	√	√
20	Purnama Kapat 1939 Saka	: Wraspati Pon Wariga	√	√
21	Tilem Kapat 1939 Saka	: Sukra Pon Julungwangi	√	√
22	Purnama Kalima 1939 Saka	: Sukra Pahiug Dunggulan	√	√
23	Tilem Kalima 1939 Saka	: Saniscara Paing Langkir	√	√
24	Purnama Kanem 1939 Saka	: Radite Paing Pahang	√	√
25	Tilem Kanem 1939 Saka	: Soma Paing Merakih	√	√