**IMPORTANT NOTICE: Journal Paper Publication Policy will be changed from JUNE 2014**

1. Only one (1) paper from same author can be included in each issue (regardless of role and order).
2. Papers from one country cannot exceed 60% in each issue (it will be calculated by checking first author's nationality).
3. Policies above will be applied from July 2014.

---

**Journal Paper Publication Policy**

1. Every published paper is readily available in our Open Access repository.
2. Maximum of thirty-nine (39) papers can be included in each issue.
3. Maximum of two (2) papers from same author can be included in each issue (regardless of role and order).
4. Each paper should have only one (1) corresponding author, and corresponding author cannot be changed.
5. If plagiarism problem was found, all authors of that paper cannot submit paper to our journal for three years. (And that paper will be removed even though it was published, and this will be noticed by home page)
6. If double submission was found, all authors of that paper cannot submit paper to our journal for three years. (And that paper will be removed even though it was published, and this will be noticed by home page)
7. Papers from one country cannot exceed 70% in each issue (it will be calculated by checking first author's nationality).
8. Only paper containing simulation, implementation, case study or other evidence of research advancement can be published. (Idea paper can be published after getting permission from editorial board)
9. Policies above will be applied from April issue of 2013.

---

**Publication and Update**

- Last day of Every Month

---

**Guidelines**

- [Publication Ethics and Malpractice Statement](#)
- [Author Guidelines](#)
Journal Topics

IJSEIA aims to facilitate and support research related to software engineering technology and the applications. To bridge the gap of users who do not have access to major databases where one should pay for every downloaded article; this online publication platform is open to all readers as part of our commitment to global scientific society.

The topics covered by IJSEIA include the following:-

**Basic Topics:**

- Component-Based Software Engineering
- Software Requirements Engineering
- Software Architectures & Design
- Information Engineering
- Mobile/Wireless Computing & Applications
- Communication Systems & Networks
- Visual and Multimedia Computing
- Intelligence
- Economic and Financial Systems
- Software Security
- Modeling with UML
- Reverse Engineering & Reengineering
- Use Cases, Scenarios
- Middleware Design Techniques
- Software Economics & Cost Modeling
- Programming Languages
- Software Tools and Development environments
- Software Policy and Ethics
- Theory, Formal Methods and Tools
- Design Patterns and Frameworks
- Software Safety and Reliability
- Web Engineering, & Web-Based Applications
- Software Process Models
- Parallel and Distributed Computing
- Data Mining, Knowledge Discovery, Artificial Intelligence
- Information Management Systems, MIS
- Software Testing & Analysis
- Software Components and Reuse
- Case Studies
- Object-Oriented Techniques
- Agent Technology
- Project Management and Maintenance
- Embedded and Real-Time Software
- Empirical Software Engineering and Metrics
- Aspect-Orientation and Feature Interaction
- Software Development Methodology
- Software Process Improvement
- Project Management
- Quality Model
- Cost Estimation
- Numerical (Statistics) Analysis Development of Algorithms
- Simulation and Design Methodology for H/W and S/W System

**Editorial Board/Reviewers**

- Abdelwahab Hamou-Lhadj, Concordia University, Canada
- Abhik Roychoudhury, National University of Singapore, Singapore
- Alok Mishra, Atilim University, Turkey
- Andrea De Lucia, Università di Salerno, Italy
- Ashesh Mahidadia, University of New South Wales, Australia
- Aymen Issa Zreikat, Mutah University, Jordan
- Bernard Wong, University of Technology, Sydney, Australia
- Bivas Dinda, Mahishamuri Ramkrishna Vidyapith, India
- Byungjoo Park, Hannam University, Korea
- Cornelia Boldyreff, University of Lincoln, UK
- D.Subbarao, Chitkara University, India
- Danilo Caivano, University of Bari, Italy
- Debnath Bhattacharyya, Heritage Inst. of Technol., Kolkata, India
- Devendra K. Tayal, Jaypee Institute of Information Technology, India
- Elizabeth Burd, University of Durham, UK
- Emilia Mendes, University of Auckland, New Zealand
- Félix García, University of Castilla-La Mancha, Spain
- Frank Houdek, Daimlerchrysler, Germany
Giovanni Cagalaban, Hannam University, Korea
Giuseppe Visaggio, University of Bari, Italy
Gregory M. Kapfhammer, Allegheny College, USA
Harvey Siy, University of Nebraska, USA
Hironori Washizaki, National Institute of Informatics, Japan
Hiroyuki Okamura, Hiroshima University, Japan
Hongji Yang, Bath Spa University, England
Houari Sahraoui, University of Montreal, Canada
Jemal H. Abawajy, Deakin University, Australia
Jianjun Zhao, Shanghai Jiao Tong University, China
Jin Song Dong, National University of Singapore, Singapore
Jonathan Lee, National Central University, Taiwan
Juan Fernandez-Ramil, The Open University, UK
Jun Bi, Tsinghua University, China
Justin Zha, Carnegie Mellon University, USA
Karl Leung, The Chinese University of Hong Kong, Hong Kong
Khademul Islam Molla, University of Tokyo, Japan
Kousalya G, Lealta Media, India
Luigi Buglione, Engineering.IT / Nexen, Italy
M. Govindarajan, Annamalai University, India
Manoel Gomes Mendonça, Salvador University, Brazil
Maricel Balitanas-Salazar, University of San Agustín, Philippines
Moinuddin Sarker, Natural State Research, Inc., USA
Nabor Chagas Mendonça, Salvador University, Brazil
N. M. Nahar, Central Arid Zone Research Institute, India
Oded Cohn, IBM Research Lab- Haifa, IL
Pavan Kumar Gorakavi, IPMA-USA Young Crew/PMI-ISSIG, USA
PAWAN JINDAL, Jaypee University of Engineering and Technology, India
Pornsiri Muenchaisri, Chulalongkorn University, Thailand
Randy Tolentino, Hannam University, Korea
Robert L. Glass, Griffith University, Australia
Rosslin John Robles, University of San Agustin, Philippines
Rudolf Ferenc, University of Szeged, Hungary
Sandor Morasca, University degli Studi dell’Insubria, Italy
SeokSoo Kim, Hannam University, Korea
Shamim Ahmad, University of Rajshahi, Bangladesh
Silvia Abrahão, Universidad Politécnica de Valencia, Spain
Somlal Das, University of Rajshahi, Bangladesh
Stan Jarzabek, National University of Singapore, Singapore
Tibor Gyimóthy, University of Szeged, Hungary
Tien Nhut Nguyen, Iowa State University, USA
Vitus Sai Wa Lam, University of Hong Kong, Hong Kong
Xiang Fu, Georgia Southwestern State University, USA
Yann-Gaël Guéhéneuc, University of Montreal, Canada
Yang-sun Lee, Seokyung University, Korea
Yijun Yu, The Open University, UK
Yong-Kee Jun, Gyeongsang National University, Korea

**IJSEIA is indexed by:**

- EBSCO
Editorial Secretary

- Ronnie D. Caytiles
## Table of Contents

### A Study on Method of Advanced Marker Array  
1  
*Donghyun Kim, Wonsuk Moon and Seoksoo Kim*

### Implementation of Software Refactoring Operation using a Code Model  
17  
*Woo-Chang Shin and Jungkyu Rho*

### A New Code Based Test Case Prioritization Technique  
31  
*Muhammad Shahid and Suhaimi Ibrahim*

### Implementation of HTTP Live Streaming for an IP Camera using an Open Source Multimedia Converter  
39  
*Gil Jin Yang, Byoung Wook Choi and Jong Hun Kim*

### Impact of route request packets to the stability of routes on static wireless networks  
51  
*Dinh Duong Mai, Anh Tai Tran and Myung Kyun Kim*

### Event Driven Architectural Style for Customer Centric eGovernment System  
67  
*Ramani. S and Y. S. Kumaraswamy*

### The Development of the Levy Assessment System for the Feasibility Analysis of Apartment Remodeling Project  
85  
*Youngwoo Nam*
Designing and Embodiment of Software that Creates Middle Ware for Resource Management in Embedded System  

Suk Hwan Moon and Cheol sick Lee

An Emotional Space Modeling for the Adaptive Emotional Model Design Based on Sugeno Fuzzy Inference  

Il-Kyoung Kwon and Sang-Yong Lee

An ISO/IEC 15504 based Software Process Assessment in Small Software Companies  

Yirsaw Ayalew and Kris Motlhala

Fuzzy Entropy Interpretation and Its Application in Deinterlacing  

Gwanggil Jeon

Design of System for Atomic, Molecular and Plasma-Material Interaction Data Exchange with XSAMS  

Jun-Hyoung Park, Mi-Young Song and Jung-Sik Yoon

Determination of Line Opening Strategies Using Tabu Search for Voltage Security  

Bonggyu Sung and Hwachang Song

Android Based Translator of Balinese into Indonesian using Binary Search Method  

A.A. Kompiang Oka Sudana, I Ketut Adi Purnawan and Ni Made Riana Mahlia Dewi
GPU-driven Parallel Processing for Realtime Creation of Tree Animation 183
Sang-Min Song, Young-Min Kang, Kang-Hyuk Lee and Soo-Yol Ok

Scheduling of Time Triggered Messages in Static Segment of FlexRay 195
Armaghan Darbandi, Sungoh Kwon and Myung Kyun Kim

An Efficient Machine Learning Approach for Identification of Operating System Processes 209
Amit Kumar and Shishir Kumar

Effectively Detecting Topic Boundaries in a News Video by Using Wikipedia 229
Jong Wook Kim and Sae-Hong Cho

How Geographic Distribution Affects Development Organizations: A Survey on Communication between Developers 241
Jongdae Han and Woosung Jung

Regression Test Cases Minimization for Object Oriented Programming using New Optimal Page Replacement Algorithm 253
Swapan Kumar Mondal and Dr. Hitesh Tahbildar

Structured Based Mobile Device Applications Enterprise Mobility 265
Regin Joy Conejar and Haeng-Kon Kim

Implementation of Mobile Internet TV Channels 273
Jaegol Yim, Gyeyoung Lee, Taekyung Lee and Junri Jeon
Research Trends on Software Requirement Prioritization 287

Rahul Thakurta

Trends, Opportunities and Challenges of Software Refactoring: A Systematic Literature Review 299

Mesfin Abebe and Cheol-Jung Yoo

Test Case Reduction Case Study for White Box Testing and Black Box Testing using Data Mining 319

Chantana Chantrapornchai, Kanitsara Kinputtan and Apaporn Santibowanwing

Virtual Assembly System for Robot Actor in Performing Art 339

Dongwook Lee, Jinsul Kim, Ilmin Kim and Minsoo Hahn
Android Based Translator of Balinese into Indonesian using Binary Search Method

A.A. Kompiang Oka Sudana¹, I Ketut Adi Purnawan² and Ni Made Riana Mahlia Dewi³

¹,²,³ Department of Information Technology, Udayana University, Bali, 80119
¹ agungokas@hotmail.com, ² dosenadi@yahoo.com, ³ rianaoegkriana@gmail.com

Abstract

Translator applications that are developed today are mostly doing the translation from national language of one country into national language of another country. This paper will discuss the translation system to perform a translation from Balinese into the target language which is Indonesian or Balinese in more specific levels. Balinese is one of the local language in the Republic of Indonesia. Balinese as an ancestral heritage should be preserved. Technology combined with the culture becomes an interesting thing to be developed. The system is built on mobile devices with the Android Operating System using Binary Search Method. Input are received by the system can be either the word or text in Balinese that would translate into the target language which selected by the user. The quality measurement of the system translation results shown the level of accuracy is 83.27%. This system was built to help people learning and understanding the local language especially Balinese more easily.

Keywords: Translator, Balinese, Indonesian, Binary Search, Android

1. Introduction

Language is a tool or an embodiment of a culture that is used to communicate or relate each other, either in writing, orally, or movement (sign language). The purpose is to convey intentions or volition to others. Humans can adapt to the customs, behavior, manners of society, and also easy to assimilate themselves with all forms of community through language.

Indonesian is the national language or the official language of the Republic of Indonesia and the Indonesian nation of unity language. Indonesian is viewed from the standpoint of linguistics is a variant of the Malay. The basis that is used is Riau Malay from the 19th century, but experienced growth due to its use as a working language and standardization process in the beginning of the 20th century. Acceptance of Malay as the basic Indonesian is caused by intralinguistic and extralinguistic factor [1].

Balinese is one of local language in Indonesia. The language is primarily spoken in some islands in Indonesia such as Bali, western part of Lombok Island, and bit at the eastern end of Java Island. Balinese language is divided into several levels, known as Bahasa Rasa. Bahasa Rasa distinguishes Balinese in politeness level of the use. Rasa Bahasa in Balinese consists of Alus Singgih (ASI), Alus Mider (AMI), Alus Sor (ASO), Andap/ Mider, and Kepara [2].

Bahasa Rasa ASI can be said have the highest level of politeness; this is generally used to honor someone who deserves to be honored. Rasa Bahasa AMI can be used to honor someone who deserve to be honored same as Rasa Bahasa ASI but can also be used to talk with the intention to humble ourselves. Rasa Bahasa ASO used to humble ourselves and talk about or talk with someone who has a lower social status. Rasa Bahasa Andap/Mider is different from the previous Rasa Bahasa, Rasa Bahasa Andap/Mider is neutral. This is commonly used in speech between someone who has been familiar,
someone who is kinship among fellow citizens, and is also used when the upper class speaks to the lower class. *Rasa Bahasa Kepara* is sense of inappropriate language or rude. This is commonly used in anger or annoyance, so it is often used in a fight [2].

2. Related Works

2.1. Binary Search Method

Binary search method is a technique for finding a particular value in a linear array, by eliminating half of the data in each step. This algorithm basically use the principle of divide and conquer, where a problem or purpose is solved by partitioning the problem into smaller parts. This algorithm divides a table into two part and selecting records with middle index of the table and then compare it with the record to be searched, if the record is lower or higher, then the table is divided into two parts and the corresponding table will be reprocessed recursively [3].

Binary search is done by dividing the array that has been sequenced into two parts with the same number or a different one if the amount of original data is odd. The data sought is then compared with the latest data on the first part. The possibility that are occurred in this case can be divided into four [4]:

a. The data sought is equal to the last element on the first part of the array. If these conditions are fulfilled means the data sought is found. Data is searched from position one to the last N position, if it is not found then the data will continue to search until it finds the same data.

b. The data sought is less than the value of the last element of array in the first part, if this condition occurs then the search continued in the first part.

c. The data sought is more than the value of the last element of array in the first part, if this condition occurs then the search co

d. In the Binary Search, the data sought would be compared with the data in the middle. The middle data being searched by summing the initial position to the final position and then the results of the sum is divided by two. The data will be compared with middle data whether larger or smaller.

Binary Search algorithm can be illustrated by conducting a search of seven value on an array as shown in Figure 1.

<table>
<thead>
<tr>
<th>Array</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 7 9 11 13 14 16 18 20 22</td>
</tr>
</tbody>
</table>

**Step 1**

<table>
<thead>
<tr>
<th>5 7 9 11 13 14 16 18 20 22</th>
</tr>
</thead>
<tbody>
<tr>
<td>A                      B       C</td>
</tr>
</tbody>
</table>

**Step 2**

<table>
<thead>
<tr>
<th>5 7 9 11 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>A            B       C</td>
</tr>
</tbody>
</table>

**Step 3**

<table>
<thead>
<tr>
<th>5 7 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>A     B       C</td>
</tr>
</tbody>
</table>

*Figure 1. Illustration of Binary Search Algorithm*
The data on the array is divided into two parts to find the middle data by summing the first data index with the last data index and divides it by two. The middle data of the array above obtained on the index-5 with the value 13 (step 1). The data sought is compared to the value of middle data, because 7 is less than 13, then the data sought must be in the left group of data, so searching is focused on the left data. The same process is repeated until the length of array is zero or data sought was found as in step 3.

2.2. Binary Search Method in SQLite

SQLite is a Relational Database Management System (RDBMS) that is commonly used on mobile devices with Android operating system. SQLite has one Input/Output (I/O) algorithm and two searching algorithms such as Brute Force string matching algorithm and a Binary Search algorithm. SQLite use Brute Force algorithm to search data which is not based on rowid while Binary Search algorithm is used to search data based on rowid [5]. Data rowid that has been sequenced in ascending will accelerate the searching process with a Binary Search algorithm.

<table>
<thead>
<tr>
<th>rowid</th>
<th>flower</th>
<th>country</th>
<th>price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mawar</td>
<td>Amerika</td>
<td>150</td>
</tr>
<tr>
<td>2</td>
<td>Anggrek</td>
<td>Afrika</td>
<td>200</td>
</tr>
<tr>
<td>5</td>
<td>Kamboja</td>
<td>Thailand</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Mawar</td>
<td>Korea</td>
<td>80</td>
</tr>
<tr>
<td>12</td>
<td>Nusa Indah</td>
<td>Filipina</td>
<td>75</td>
</tr>
<tr>
<td>14</td>
<td>Lili</td>
<td>Rusia</td>
<td>300</td>
</tr>
</tbody>
</table>

Table 1 is an example of a table in SQLite. A query is executed to find the value of flowers price by the name "Lili". This searching is not a search based on rowid, so the process will not be done by Binary Search methods. The solution provided by SQLite in order to do this searching with binary search process is by create the index. Index is another table similar to the original table 'price_flower' but with content inside is a column that contains the data to be matched with the data sought (in this example is the 'flower' column). 'flower' column stored in the front of rowed column with all rows are sorted in ascending according to content (the 'flower' column) sequence.

<table>
<thead>
<tr>
<th>flower</th>
<th>rowid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anggrek</td>
<td>2</td>
</tr>
<tr>
<td>Kamboja</td>
<td>5</td>
</tr>
<tr>
<td>Lili</td>
<td>14</td>
</tr>
<tr>
<td>Mawar</td>
<td>1</td>
</tr>
<tr>
<td>Mawar</td>
<td>7</td>
</tr>
<tr>
<td>Nusa Indah</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 2 is an index table of the 'flower' column which has been sorted in ascending with rowid column is sequenced follow the 'flower' column, this index is called 'idx_flower'. 'flower' column in index below act as the primary key, while 'rowid' act as an indicator when there are the same value of 'flower' column. The unique characteristic of rowid resulted a combination of two columns ('rowid' and 'flower') will always be unique.

The index will help to search data which is not based on rowed faster. For example, to be able to know the price of 'Lili' such as the previously mentioned query, the query will begin to perform Binary Search on 'idx_flower' index for row with 'Lili' value. SQLite can perform Binary Search on 'idx_flower' index because rows in 'idx_flower' index are sorted acording to the 'flower' column, this is different from the conditions in table...
'flower_price'. After finding row in the index with the 'Lili' value of 'flower' column, then the database engine will extract the rowid of this row. This rowid then used to perform Binary Search on table 'flower_price' to find the original row with value 'Lili' at the table 'flower_price', then extract the information sought which is the 'price' on that line. These steps can be illustrated as shown in Figure 2.

<table>
<thead>
<tr>
<th>flower</th>
<th>rowid</th>
<th>flower</th>
<th>country</th>
<th>price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anggrek</td>
<td>2</td>
<td>Mawar</td>
<td>Amerika</td>
<td>150000</td>
</tr>
<tr>
<td>Kamboja</td>
<td>5</td>
<td>Anggrek</td>
<td>Afrika</td>
<td>200000</td>
</tr>
<tr>
<td>Lili</td>
<td>14</td>
<td>Kamboja</td>
<td>Thailand</td>
<td>50000</td>
</tr>
<tr>
<td>Mawar</td>
<td>1</td>
<td>Mawar</td>
<td>Korea</td>
<td>80000</td>
</tr>
<tr>
<td>Mawar</td>
<td>7</td>
<td>Nusa Indah</td>
<td>Filipina</td>
<td>75000</td>
</tr>
<tr>
<td>Nusa Indah</td>
<td>12</td>
<td>Lili</td>
<td>Rusia</td>
<td>30000</td>
</tr>
</tbody>
</table>

Figure 2. The Use of Index for Searching the Price of 'Lili'

Two times Binary Search process that must be performed on index and original table is much faster than doing one overall table lookup using Brute Force especially for data with much number of rows. This analysis result showed that the time was required to search a string in 24.198 rows of data using the Brute Force method amounted to 126 milliseconds, while using the Binary Search method with the aid of index only takes 1 millisecond.

3. System Overview

Architecture, modules, and the use case diagrams of the system will be described in this section.

3.1. System Architecture and Modules

Balinese into Indonesian translation system is a system that is built on two sides, on the client side and the server side. The two sides of this system can be connected each other using the web service through the Internet network. This connection is used to manage the updates of database on the client application. Web Service is defined as an interface that describes a set of operations that can be accessed through a network such as the Internet in the form of XML messages (eXtensible Markup Language). Web services provide a standard communication between various of different software applications and can runs on a variety of platforms or frameworks [6]. Generally the system can be described as shown in Figure 3.
The web application is used to perform management of the master data such as adding data, deleting data, and changing data. This is also used to manage the update process of the database on client application (Android app). Generally the existing modules in web application are Management Update Module, Tata Bahasa Module, Kata Bali Module, and Management User Module.

Management Update Module is functioned to update the database on the client application when there is a change of data in the database server. Management Update Module on the server sends information updates and data that has been updated to the client application.

Tata Bahasa Module is functioned to do the addition, changing and deletion of grammar master data, such as master data types of the word, types of morphology, morphological rules, affixes and types of affixes, and types of Rasa Bahasa in Balinese. All of this data are associated with the various rules and morphological processes in Balinese. Balinese grammar rules that is managed in this module is used as guidelines for the word morphological process that occur in Kata Bali Module.

Kata Bali Module is used to perform manipulations on word dictionary in database system. Manipulation can be in the form of addition, deletion, and changing to Balinese words data and Balinese word dictionary. Input that is given in the form of Balinese word data which will be added to the database. This module also plays a role in the word morphological process of the Balinese word input that is given by user (administrator). The word morphological process combine the word input with affixes, this process is done based on morphological rules which are stored in the database and are managed in Tata Bahasa Module. Based on derivatives displayed then can be selected the words that are appropriate. Furthermore administrator can input the meaning of each selected words in Indonesian and Balinese then store it into database.

Management User Module is one of module in web application that is used to manage manipulation processes of user data. User of the web applications is the system administrator because web application is solely devoted as a web server that manages the master data in the database system.

The client application which is built on the Android mobile operating system can be divided into three modules, namely Management Update Module, Translator Module, and Sinonim Module. Translator Module can be considered as the core module in the system. This is because there is a process of translation which is the purpose or function of the system. This module processes the input in the form of Balinese words or text from user to produce a translation in the target language that is selected directly by user. Target language can be Indonesian or Balinese in more specific levels.

Sinonim Module is used to search synonyms of Balinese word or combination of words (phrase). Sinonim Module processes words that are inputted by user into the synonyms of that word in Balinese. Input on Sinonim Module is limited only for a Balinese word or phrase. Word or phrase is inputted by user query to the database to find its synonyms. Then the results were displayed to the user.

Management Update Module on the client application manages the database of the client application to fit the database on the web application (web server). Changes that occur in the database server will be informed to the client application. Notification of these updates will be received by client application when client mobile device connected to the Internet network. Through these notifications users are notified that there has been an update on the system and recommended to download the update (in this case updates occurred on database). If the user agrees, then the client application will send a confirmation to the server and followed by response from the server in the form of an updated database. Management Update Module in client application will manages all of these processes.
Figure 4. The Structure and Relations between Tables in Database

Figure 4 shows the the structure and relations between the existing table in database system. Each table holds each role, especially on translation process. Management of data on each table occurs on the existing modules especially in application server.

3.2. Use Case Diagram System

Activities that can be done by user or administrator on the system can be described in a use case diagram. Use case diagrams describe the interaction between user and the system is built, and describes functionality that can be provided to system users [6].

Figure 5. Use Case Diagram of Client Application

Use case diagrams of Balinese into Indonesian translation system in Android based mobile devices can be seen in Figure 5. Users can choose three main modes such as Translation Mode, Synonym Mode, and Information Mode. Translation Mode is used to perform the translation process and the Synonym Mode is used to search for synonyms as described in the previous section. Information Mode contains information about the source language (Balinese) and the target languages of
translations are available on the system, which is Indonesian and Balinese in more specific levels. Users can enter a Balinese word or text to be translated in the Translation Mode and select the target language of translation.

Use case diagram graphically describes the system as a collection of use cases, actors (users), and the relationship between them is labeled association called initiation [7]. Use case diagram on application server is different with the use case diagram on the client application because server is functioned solely to manage the data in the database. The activities that can be performed on server are more than client’s due to amount of table master that must be managed in the database.

![Use Case Diagram of Application Server](image)

**Figure 6. Use Case Diagram of Application Server**

Figure 6 shows the activities that can be performed by administrator on the application server. Administrators can select the Grammar Menu where there are several activities can be performed such as manipulation of word types data and type of morphology data either in Indonesian and Balinese, types of affix data, affixes data, morphological data, and the data of *Rasa Bahasa* in Balinese. Administrators can select the Balinese Word Menu to perform manipulation of Balinese word dictionary data. Administrators can also choose User Management Menu to manipulate the server user data and do an update through the Management Update Menu. Application server is specifically used to perform master data management in database as shown in the picture of use case diagram in Figure 6.

4. Implementation and Analysis

Implementation of the system is performed on the client side and server side. Implementation of the system on the client side is performed by using Android based mobile devices and the server can be accessed via a web browser.
4.1. Implementation of Morphological Process in Web Server

Application server manage master data in database especially manipulation of the Balinese word dictionary data and morphological processes inside. Morphological process is a formation process of word from basic word into a derivative by adding affixes to the basic word according to the morphology rules [8].

**Figure 7. Flowchart of Morphological Process**

Input of basic word and types of word in Balinese that is given by administrator combined with the affixes data that are stored in the database. This incorporation is adapted with morphology rules in the database to produce corresponding derivative. Morphological process that occur in the application server can be seen in Figure 7. Input of Balinese word and type of word given by administrator are processed to produce derivatives. Word that can be generated into derivative is a word with the class type ‘terbuka’. Word with this class types is combined with 37 affixes in Balinese that are stored in ‘tb_afiks’ table. This merging is done based on existing morphological rules in ‘tb_morfologi’ table to generate the corresponding derivatives. The trials of morphological process of input word “tembang” produces 37 derivatives that can be seen in Table 3.
Table 3. Derivatives of “tembang”

<table>
<thead>
<tr>
<th>No.</th>
<th>Affix + word</th>
<th>derivative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>n- + tembang</td>
<td>nembang</td>
</tr>
<tr>
<td>2</td>
<td>ma- + tembang</td>
<td>matembang</td>
</tr>
<tr>
<td>3</td>
<td>ka- + tembang</td>
<td>katembang</td>
</tr>
<tr>
<td>4</td>
<td>pa- + tembang</td>
<td>patembang</td>
</tr>
<tr>
<td>5</td>
<td>pi- + tembang</td>
<td>pitembang</td>
</tr>
<tr>
<td>6</td>
<td>sa- + tembang</td>
<td>satembang</td>
</tr>
<tr>
<td>7</td>
<td>a- + tembang</td>
<td>atembang</td>
</tr>
<tr>
<td>8</td>
<td>pra- + tembang</td>
<td>pratembang</td>
</tr>
<tr>
<td>9</td>
<td>pari- + tembang</td>
<td>paritembang</td>
</tr>
<tr>
<td>10</td>
<td>pati- + tembang</td>
<td>patitembang</td>
</tr>
<tr>
<td>11</td>
<td>maka- + tembang</td>
<td>makatembang</td>
</tr>
<tr>
<td>12</td>
<td>saka- + tembang</td>
<td>sakatembang</td>
</tr>
<tr>
<td>13</td>
<td>kuma- + tembang</td>
<td>kumatembang</td>
</tr>
<tr>
<td>14</td>
<td>-um- + tembang</td>
<td>tunembang</td>
</tr>
<tr>
<td>15</td>
<td>-in- + tembang</td>
<td>tinembang</td>
</tr>
<tr>
<td>16</td>
<td>-el- + tembang</td>
<td>telembang</td>
</tr>
<tr>
<td>17</td>
<td>-er- + tembang</td>
<td>terembang</td>
</tr>
<tr>
<td>18</td>
<td>-a + tembang</td>
<td>tembanga</td>
</tr>
<tr>
<td>19</td>
<td>-ang + tembang</td>
<td>tembangang</td>
</tr>
<tr>
<td>20</td>
<td>-in + tembang</td>
<td>tembangin</td>
</tr>
<tr>
<td>21</td>
<td>-an + tembang</td>
<td>tembangan</td>
</tr>
<tr>
<td>22</td>
<td>-e + tembang</td>
<td>tembange</td>
</tr>
<tr>
<td>23</td>
<td>-ne + tembang</td>
<td>tembangne</td>
</tr>
<tr>
<td>24</td>
<td>-n + tembang</td>
<td>tembangn</td>
</tr>
<tr>
<td>25</td>
<td>-ing + tembang</td>
<td>tembanging</td>
</tr>
<tr>
<td>26</td>
<td>pa-an + tembang</td>
<td>patembangan</td>
</tr>
<tr>
<td>27</td>
<td>ma-an + tembang</td>
<td>matembangan</td>
</tr>
<tr>
<td>28</td>
<td>ka-an + tembang</td>
<td>katembangan</td>
</tr>
<tr>
<td>29</td>
<td>bra-an + tembang</td>
<td>bratembangan</td>
</tr>
<tr>
<td>30</td>
<td>n-ang + tembang</td>
<td>nembangang</td>
</tr>
<tr>
<td>31</td>
<td>n-in + tembang</td>
<td>nembangin</td>
</tr>
<tr>
<td>32</td>
<td>ka-ang + tembang</td>
<td>katembangang</td>
</tr>
<tr>
<td>33</td>
<td>ka-in + tembang</td>
<td>katembangin</td>
</tr>
<tr>
<td>34</td>
<td>ma-ang + tembang</td>
<td>matembangang</td>
</tr>
<tr>
<td>35</td>
<td>ma-in + tembang</td>
<td>matembangan</td>
</tr>
<tr>
<td>36</td>
<td>pa-in + tembang</td>
<td>patembangan</td>
</tr>
<tr>
<td>37</td>
<td>pa-ang + tembang</td>
<td>patembangang</td>
</tr>
</tbody>
</table>

The administrator can choose the appropriate words from the derivatives by checking the checkbox on the right side of the system. The administrator can enter information of each selected words to be added to the Balinese word data dictionary in database. This process is done one by one for each selected word. This process will be discussed in the next section. Figure 8 shows the trials of morphological process that occur in the application server.
4.2. Process of Adding the Word Translation

Derivatives which are generated in the morphological process can be selected the appropriate words. Administrator further can insert the information of each selected word such as types of the word, Rasa Bahasa in Balinese, and the translation of the word in Indonesian. This process can be illustrated in a flowchart in Figure 9.

Figure 8. The Trials of Morphological Process on Application Server

Figure 9. Process of Inserting the Word Information Data

Derivative along with informations given are stored in the ‘tb_kamusindobali’ table of database system. This data plays an important role on the translation process. By inserting the translation and other information of these words, the Balinese word dictionary data in ‘tb_kamusindobali’ table will increase. These additions make a changes to the database server which must be communicated to the client application. The information update is sent to the client application through the web server Manajemen Update Module by the administrator, so that the client can download the update. This process on the client application is also managed by
Thus, the output of the translation result are then combined to produce a translation process. The translation process generally begins with reading the user input and split it into word per word. Each word is then searched its translation in database system according to the target language is selected by the user. The words of the translation result are then combined to produce a translation accordance to input.

Input word is matched with a list of words in ‘kata_bali’ column of ‘tb_katabali’ table before it is searched for its translation on ‘tb_kamusindobali’ table. Searching process of input word in this table is not based on rowid. Indexes are created in order to help this process can be done by Binary Search method.

![Figure 10. The Translation Process with a Binary Search Method](image_url)

Figure 10 shows the flow of the translation process that occurs in the system. Stored data in the database tables plays a central role in the translation process. The translation process generally begins with reading the user input and split it into word per word. Each word is then searched its translation in database system according to the target language is selected by the user. The words of the translation result are then combined to produce a translation accordance to input.

Input word is matched with a list of words in ‘kata_bali’ column of ‘tb_katabali’ table before it is searched for its translation on ‘tb_kamusindobali’ table. Searching process of input word in this table is not based on rowid. Indexes are created in order to help this process can be done by Binary Search method.
The structure of the database system consists of several indexes. Index is created in order to make the search of data that is not based on rowid in the translation process can be done with Binary Search method. One of index that is created named ‘idx_katabali’. This index contains data of ‘kata_bali’ column which is taken from the ‘tb_katabali’ table. Figure 11 shows an illustration of the search process of input word in ‘tb_katabali’ table with the help of ‘idx_katabali’ index. The search is conducted with input in the form of the word “gede”.

<table>
<thead>
<tr>
<th>kata_bali</th>
<th>rowid</th>
</tr>
</thead>
<tbody>
<tr>
<td>aben</td>
<td>5</td>
</tr>
<tr>
<td>ageng</td>
<td>1</td>
</tr>
<tr>
<td>agung</td>
<td>2</td>
</tr>
<tr>
<td>gede</td>
<td>3</td>
</tr>
<tr>
<td>taluh</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>rowid</th>
<th>id_katabali</th>
<th>id_jeniskata</th>
<th>kata_bali</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
<td>ageng</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td>agung</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>gede</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>1</td>
<td>taluh</td>
</tr>
<tr>
<td>5</td>
<td>13</td>
<td>1</td>
<td>aben</td>
</tr>
</tbody>
</table>

Figure 11. Word Searching on Index using Binary Search

‘kata_bali’ column contains data of Balinese words which plays an important role in the translation process. Input word are matched with the data in this column to find its ID in ‘id_katabali’ column and the ID of its word type in ‘id_jeniskata’ column. These data are then used to find the translation of the input word in the ‘tb_kamusindobali’ table. Several other indexes are also made to make the further searching process is still being done by Binary Search method until it produce the translation result.

4.4. System Trials

Translator mode on the client application can receive input from user in the form of word, combination of words (phrases), sentences, paragraphs or text in Balinese. Translation process occur in this mode generally begins with reading the user input and split it becomes word per word. Each word is matched by words that are stored in the database. Then the matched word is searched the translation in Balinese word dictionary according to the selected target language. Searching results of each word then combined into sentences or paragraphs according to user input and then displayed as a result of the translation. The process of matching and searches performed to the data in the database is done with Binary Search methods. Blue words on the translation result are the words that are successfully translated by the system and can be clicked to see the options of alternative words. The alternative word is another word that is also become the translation of the word that is entered by user.

Explicit relationship that connect sense of the word helps explore the word translation by navigating lexical relations [9]. The application has an alternative words feature where user can view other alternative words which are also the translation result of the inputted word. This option words can be viewed by clicking on the blue word of the translation result. The example is when user translates the sentence “Meme miara bebek” into Indonesian then the translation result is “Ibu memelihara itik”. The words of the translation result coloured blue can be clicked to see whether the alternative words are available or not. The word “itik” as the translation of the word “bebek” in the example case has the other alternative word that is “bebek” which can be viewed by clicking on the word “itik” as shown in Figure 12.
User can change the word of translation result by selecting the word from the alternative words option list. The selection of the alternative words can be done when the word of the system translation result is considered less appropriate to the context of the sentence and the word in the alternatives word option list is considered more appropriate or more suitable to the context of the translated sentence. Example of selecting the word from list of alternative words can be seen in Figure 13.

Mode of synonym can receive input in the form of word or combinations of words (phrase) in Balinese. Balinese word or phrase input that is given by user can be searched the synonym in variety of more specific Balinese Rasa Bahasa such as ASI, AMI, ASO, Mider/Andap, and Kepara. The searching process of synonym that takes place in this mode are generally preceded by reading the user given input and match them with the
words in the database which has the same meaning. Corresponding words will be displayed as a synonym result which are classified based on Balinese Rasa Bahasa. The trial of synonym searching with input in the form of word is done on the word “bapa”. The synonym searching result of the word "bapa" was obtained in a five Balinese Rasa Bahasa as shown in Table 4.

### Table 4. The Synonym Searching Result of the Word “bapa”

<table>
<thead>
<tr>
<th>ASI</th>
<th>AMI</th>
<th>ASO</th>
<th>Mider/Andap</th>
<th>Kepara</th>
</tr>
</thead>
<tbody>
<tr>
<td>aji</td>
<td>aji</td>
<td>bapa</td>
<td>bapa</td>
<td>bapak</td>
</tr>
<tr>
<td>ajung</td>
<td></td>
<td></td>
<td></td>
<td>nanang</td>
</tr>
</tbody>
</table>

#### 4.3. System Analysis

The analysis of the system is performed on the time process needed by system to do a translation and analysis of the quality of the translations result. Analysis of the system time process is done by measuring the time process of the translation for the input of the words, phrases, sentences, and paragraphs. The samples are used in these trials in the form of five words, five phrases, five sentences, and five paragraphs. Test is performed six times on each sample input to get better analysis of the results. Each trials has been done were analyzed separately for each words, phrases, sentences, and paragraphs.

![The Average of Translation Time Processing](image)

**Figure 14. The average graph of translation time processing**

Figure 14 shows the average time processing required to perform the translation process for each type of given input. The graph shows the average time processing required is directly proportional to the number of word in the input. This condition is caused by the process of system translation is done per word, so that more number of word in the input then the longer it takes to translate.

Analysis of system testing is also performed by measuring the quality of the application translation result. Measuring the quality of the translation is done by independent evaluation using measurement criteria from the point of view of the accuracy. The accuracy can be defined as how far the messages in the source language text are presented correctly in the target language text. The accuracy indicates extent to which the translation result has the ‘same’ information as the original [10].

Five samples text of translation result are selected to be evaluated based on the criteria of accuracy to find valuation of each system translation result. The samples were Balinese paragraphs that are taken randomly from several Balinese articles in www.balipost.co.id website. Each sample consists of a paragraph with total number of word are 55 words.
The number of word in each sample is same, so calculation of translation results quality can be done.

The paragraphs are translated into Indonesian. Evaluation is done by counting the number of words that is wrong or not appropriate on the system translation result which made change meaning of the original paragraph. Analysis of the calculation results are performed to obtain the percentage of translation result quality of Android based Balinese into Indonesian translation system. Table 5 shows the number of word errors in translation result for each paragraph was tested.

<table>
<thead>
<tr>
<th>paragraph</th>
<th>the number of words error</th>
<th>the number of words true</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9</td>
<td>46</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>48</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>42</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>52</td>
</tr>
<tr>
<td>5</td>
<td>14</td>
<td>41</td>
</tr>
<tr>
<td>total</td>
<td>46</td>
<td>229</td>
</tr>
</tbody>
</table>

Percentage of the translation result quality of Android based Balinese into Indonesian translation system can be known by calculating the error value of the translation results by using the following calculation formula:

$$\text{Error value} = \frac{\text{total error}}{\text{total word}} \times 100\%$$

The calculation of error value based on the above formula produces the error rate for translation result of Android based Balinese into Indonesian translation system amounted 16.73%. The quality of the translation results is obtained by subtracting 100% with percentage of the translation error value, thus produced percentage of the system translation result quality in the amount of 83.27%.

5. Conclusions

The method used in the system translation process, testing, and analysis system has been performed and described in the previous discussion. Several conclusions can be taken based on those descriptions are:

a. Using a binary search method in Balinese into Indonesian translation process can shorten the time processing.

b. The average time processing required to translate the input in the form of word, combinations of words (phrase), sentence, or paragraph directly proportional to the number of words constituent each of input.

c. Independent evaluation with the criteria of accuracy shows the percentage of system translation quality amounted 83.27%.

References


Authors

A. A. Kompiang Oka Sudana, received his S.Kom degree in Informatics Engineering from Institut Teknologi Sepuluh Nopember University in 1997, and his MT. degree in Informatics and Computer System from Gadjah Mada University in 2001. He was Technical Manager at PT. INFOS Teknologi Indonesia (Software Developer) during April 2008–Sept. 2008. Information Technology Leader–Human Resources and General Affair Division at PT JAS Catering International Airport Ngurah Rai Bali during April 2003–July 2006, Person in Charge of Technological and Professional Skills Development Sector Project (TPSDP)–Asian Development Bank (ADB) Loan, Batch II in Electrical Engineering Study Program during 2002-2006, and he is currently lecturer at Magisterial Program of Electrical Engineering Department of Udayana University, lecturer at Electrical Engineering Department (major in Computer System and Informatics) of Udayana University, lecturer at Information Technology Department of Udayana University, and member of Development Project Team of Academic Management Information System and Networking Implementation of Udayana University. His research experiences are in Analysis and Design of Information Systems, Image Processing, Biometric Identification and Recognition, Implementation Information Technology in Balinese Culture.

I Ketut Adi Purnawan, received his S.T. degree in Informatics and Computer System from Gadjah Mada University in 2007, and his M.Eng. degree in Informatics and Computer System from Gadjah Mada University in 2008. He is currently a lecturer at Udayana University and specialize in information technology, expert system, enterprise architecture, IT governance strategies, and electronic policies.
Ni Made Riana Mahlia Dewi, received her S.TI. degree in Information Technology from Udayana University on 2014. Her research experience were combine culture and technology also analyze and design an information systems.