

CONSTRUCTION OF A DIGITAL RESOURCE INFORMATION AND  
DIAGNOSTIC TOOL FOR BRAIN DISEASES

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CONSTRUCTION OF A DIGITAL RESOURCE INFORMATION AND  
DIAGNOSTIC TOOL FOR BRAIN DISEASES

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To my beloved father and mother

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## ABSTRACT

Brain Disease Knowledgebase (<http://birg1.fbb.utm.my/bddb>) is a novel comprehensive database of the 62 brain diseases. Different types of brain diseases information were determined from online survey and existing databases comparison. Biomarker, drug and protein data were mined from various scientific databases via different approaches such as web services and Perl script. Dementia diagnostic platform was designed in two types, web-based and android-based, from digitalisation of three common-used screening tests that are originally distributed by medical professionals. The data mined and diagnosis platform were then processed to form content to display. After webpage layout was designed, Brain Disease Knowledge Database (BDDDB) is completed. The availability of BDDDB will provide accurate information to the general public and act as a valuable knowledge vault to assist research in brain diseases. Users are able to automatically retrieve updated information, publications and statistics on brain diseases. BDDDB has novel scientific data consisting of disease biomarkers and clinical methodologies. The data have been organized into different user types suitable for general public, medical professionals and scientific researchers. The Database is integrated with the digitized diagnostic tools approved by certified medical doctors, enabling fast self-accessed preliminary dementia diagnosis which is also accessible through mobile platform.

## ABSTRAK

Pangkalan data penyakit otak BDDDB (<http://birg1.fbb.utm.my/bddb>) adalah pangkalan data yang novel dan komprehensif merangkumi data 62 jenis penyakit otak. Maklumat penyakit otak didapati melalui kaji selidik dalam talian dan perbandingan antara pangkalan data yang sedia ada. Data-data penanda biologi, ubat rawatan dan protein diperolehi daripada pelbagai pangkalan data saintifik dengan menggunakan pelbagai pendekatan seperti perkhidmatan laman web dan skrip Perl. Platform diagnostik demensia dibina dalam dua jenis, berasaskan laman web dan android, dengan mendigitalkan tiga jenis ujian saringan asli yang diedarkan oleh pakar-pakar perubatan. Data-data yang diperolehi dan platform diagnostik diproses untuk membentuk isi-isi yang bakal dipamerkan. Pangkalan data penyakit otak adalah lengkap selepas reka bentuk pameran laman web diwujudkan. Kewujudan BDDDB menyediakan maklumat yang tepat kepada masyarakat umum dan membantu penyelidik-penyelidik dalam menjalankan penyelidikan yang berkaitan dengan penyakit otak. Pengguna boleh mendapatkan data, penerbitan dan statistik terkini yang berkaitan dengan penyakit-penyakit otak. BDDDB juga menyediakan data saintifik yang novel, termasuk penanda biologi penyakit dan metodologi klinikal. Data-data telah disusun dalam berbagai bentuk sesuai untuk masyarakat umum, pakar-pakar perubatan dan penyelidik saintifik. Pangkalan data diintegrasikan dengan alat diagnostik digital yang telah diluluskan oleh doktor perubatan yang diperakui, bagi membolehkan capaian maklumat awal yang pantas atas penyakit demensia. Data juga dapat dicapai melalui platform mudah alih.

## TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	<b>DECLARATION</b>	i
	<b>DEDICATION</b>	ii
	<b>ACKNOWLEDGEMENT</b>	iii
	<b>ABSTRACT</b>	iv
	<b>ABSTRAK</b>	v
	<b>TABLE OF CONTENT</b>	vi
	<b>LIST OF TABLES</b>	ix
	<b>LIST OF FIGURES</b>	x
	<b>LIST OF ABBREVIATIONS</b>	xii
	<b>LIST OF APPENDICES</b>	xiv
<b>1</b>	<b>INTRODUCTION</b>	1
	1.1 Background	1
	1.2 Problem Statement	2
	1.3 Objectives	2
	1.4 Research Significance	2
	1.5 Work Scope	2
<b>2</b>	<b>LITERATURE REVIEW</b>	4
	2.1 Brain Diseases	4
	2.1.1 Dementia	5
	2.2 Biomarker	6
	2.2.1 Biomarker of Brain Diseases	7
	2.3 Treatment in Brain Diseases	9

2.4	Web 2.0 and Disease Oriented Databases	9
2.5	Data Mining	11
2.5.1	Web Services	12
2.5.2	Biological Databases and Tools	15
2.6	Database Design	16
2.7	Data Model	16
2.7.1	Hierarchical and Network Model	17
2.7.2	Relational Model	18
2.7.3	Object-oriented Model	19
2.8	Clinical Diagnostic Tools	20
<b>3</b>	<b>RESEARCH METHODOLOGY</b>	<b>22</b>
3.1	Workflow of Research	22
3.1.1	Online Survey and Database Comparison	23
3.2	Data Mining and Pre-processing	23
3.2.1	Biomarkers Data Processing	24
3.2.2	Protein Data Processing	25
3.2.2.1	Strap Viewer	25
3.2.3	Drug Data Processing	26
3.2.4	Recent Publication Data Retrieval	26
3.2.5	Protein-protein Interaction Map Retrieval	26
3.3	Web-based Dementia Diagnostic Platforms	27
3.4	Patient Management System	27
3.5	Website Design	27
3.5.1	User Oriented Web Interface	28
<b>4</b>	<b>RESULT AND DISCUSSION</b>	<b>29</b>
4.1	Identification of 62 Brain Diseases	29
4.2	Database Scope Analysis	30
4.2.1	Mining for Ontologies	30
4.2.2	Database Comparison	31
4.3	Data Management, Utilization and Application	32



4.3.1	The Data Model	32
4.3.2	Biomarkers Data Mining	34
4.3.3	Protein and Drug Data Mining	35
4.3.4	Recent Publication Retrieval	37
4.3.5	Protein-protein Interaction Map Retrieval	39
4.4	Online Dementia Diagnosis Platform Design	39
4.5	Patient Management System	42
4.6	The Website Design	42
4.6.1	The Web Architecture	42
4.6.2	User Accessibility and Use Case	43
4.6.3	User Interface Design	45
4.7	User Acceptance Measurement	49
4.7.1	User Acceptance Test	50
4.7.2	Conference and Exhibition Participation	51
<b>5</b>	<b>CONCLUSION</b>	<b>51</b>
5.1	Conclusion	51
5.2	Suggestion for Future Work	52
	<b>REFERENCES</b>	<b>53</b>
	Appendices A-H	67-89

**LIST OF TABLES**

<b>TABLE NO.</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	AD dementia biomarkers and its criteria predescribed	8
2.2	Disease-oriented databases	10
2.3	Data mining approaches	12
2.4	Comparison of RESTful and SOA based web services	14
2.5	List of biological databases	15
2.6	The steps taken for database creation	16
2.7	The different types of data model	16
2.8	The CUSTOMER table with composite primary key (underlined)	19
2.9	The current available diagnosis tools	21
3.1	Approaches of data mining	23
4.1	The functional content comparison among brain disease databases	31
4.2	The number of set for each type of data mined from respective source	34
4.3	The biomarkers information mined	34

## LIST OF FIGURES

<b>FIGURE NO.</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	The REST-style workflow	13
2.2	SOA-style workflow	14
2.3	The hierarchical model with 1:n relationship	17
2.4	The network model with n:n relationship	17
2.5	The example of Entity Relationship (ER) diagram	18
2.6	The relational tables built according to ER diagram	19
2.7	The object-oriented model with hospital information system as example	20
3.1	BDDDB work flow	22
4.1	The Brain Foundation Site	30
4.2	GoPubMed generated statistics for brain disease	31
4.3	The ER diagram of BDDDB	33
4.4	The associated protein page	36
4.5	The drug information page	37
4.6	The most three recent papers in the PubMed database	38
4.7	The PPI map image retrieved on-the-fly	39
4.8a	Digital form of AD8 Dementia Screening Interview	40
4.8b	The original AD8 Dementia Screening Interview distributed by the authors	40
4.9	The total point scored and the possibility was measured	40
4.10	Mobile application interfaces	41

4.11	User account	42
4.12	Web architecture	43
4.13	Data organization of BDDDB	44
4.14	Use case of BDDDB	45
4.15	BDDDB homepage	46
4.16	Disease selection page	46
4.17	Brain disease profile page	47
4.18	Associated protein list	48
4.19	STRAP Viewer	48
4.202	Drug profile	49

## LIST OF ABBREVIATIONS

1:n	-	One-to-many
ADHD	-	Attention Deficit Hyperactivity
AGDDB	-	Arab Genetic Disease Database
API	-	Application programming interface
BDDDB	-	Brain Disease Knowledgebase
Brenda	-	The Comprehensive Enzyme Information System
CATH	-	Protein Structure Classification database
CDSS	-	Clinical Diagnosis Support System
CIPD	-	Chronic Inflammatory Demyelinating Polyneuropathy
CSF	-	Cerebrospinal fluid
CSS	-	Cascading Style Sheets
DALY	-	Disability-adjusted life year
DDBJ	-	DNA Data Bank of Japan
DIP	-	Database of Interacting Proteins
EC	-	Enzyme Commission number
EMBL	-	European Molecular Biology Laboratory
EPO	-	Erythropoietin
ER	-	Entity Relationship
Expasy	-	SIB Bioinformatics Resource Portal
GBD	-	Golden Burden of Disease
GenBank	-	NIH genetic sequence database
GUI	-	Graphic User Interface
HIV	-	Human immunodeficiency virus
HTML	-	Hyper Text Markup Language
ICD	-	International Classification of Diseases Code
MMSE	-	Mini Mental State Examination
NCBI	-	National Center of Biotechnology Information

NIH	-	National Institute of Health
PDB	-	Protein Data Bank
Perl	-	Practical Extraction and Report Language
PET	-	Positron Emission Tomography
PIR	-	Protein Information Resource
PMID	-	PubMed ID
PPI	-	Protein-protein Interaction
PROSITE	-	Database of protein domains, families and functional sites
PubMed	-	National Library of Medicine
regex	-	Regular Expression
RDBMS	-	Relational Database Management System
REST	-	Representational State Transfer
RESTful	-	REST-based Architecture
SCOP	-	Structural Classification of Proteins
SDS	-	Symptoms of Dementia Screener
SMRIDB	-	The Stanley Medical Research Institute online genomics database
SOA	-	Service-oriented architecture
STRING	-	Search Tool for the Retrieval of Interacting Genes/Proteins
UAT	-	User Acceptance Test
UniProt	-	Universal Protein knowledgebase
URL	-	Uniform resource locator
WHO	-	World Health Organisation
XML	-	Extensible Markup Language

## LIST OF APPENDICES

<b>APPENDIX</b>	<b>TITLE</b>	<b>PAGE</b>
A	Australian Brain Foundation	67
B	62 Brain Diseases with Assigned diseaseID and ICD-10 Code	68
C	E-Utilities by NCBI	70
D	Perl Script To Download The Abstracts Of Literature from PubMed	71
E	PHP:simplexml_load_file to Process XML-Formatted File	72
F	PHP Script to Retrieve Recent Publication	73
G	PHP Script to Analyse The Possibility of Dementia	74
H	PHP:Include and PHP:Sessions	75
I	The Summary of Data Mining (number of bundle)	76
J	User Acceptance Test	79
K	The Certificate of Forth Regional Conference on Molecular Medicine (RCMM) 2011	87
L	The Published Proceeding of BDDB	88
M	The Young Investigator Award	89

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Brain is a well-studied organ and is associated with various diseases that are usually lethal, incurable and multi-causal (Olde Rikkert *et al*, 2006; Rikkert *et al*, 2005). The treatment of these brain diseases are known to be difficult and prolonged due to the complexity of brain structure (Berg *et al*, 1978; Laterza *et al*, 2006). Currently, there is a significant increase in the number of patients with various brain disorders, especially neurodegenerative diseases and tumours, creating a global competition of novel biomarker discovery and treatment development (Laterza *et al*, 2006). The Alzheimer's disease Foundation Malaysia (ADFM) reported in 2006 that there are approximately 60,000 Malaysian affected by dementia. Consequently, an increasing number of research have been conducted to focus on the disease (Chen and Berry, 2003; Hyson, 2010; Mattson *et al*, 2001; Vercauteren *et al*, 2004). These studies had generated large quantities of biological and experimental data that requires the development of improved bioinformatics and computational tools to efficiently manage the data. Thus, research team aim to fill this need by creating the Brain Disease Database that is aimed to be a broad brain disease database that provides disease, biomarkers, protein and drug data. It will be intuitively designed, easy and simplified for self-assessed dementia diagnostic platforms, which will benefits the general public and researchers alike.



## **1.2 Problem Statement**

Although finding relevant on different brain diseases is a straightforward process, the data is scattered over various databases, exists in multiple formats and generally unorganized, requiring queries to be. Currently, there is no existing comprehensive data model and data management system that specifically focuses on multiple brain diseases.

## **1.3 Objectives**

The research objectives are:

- To determine scope and mine of brain disease data
- To design a data model and process model for brain disease database
- To implement, test and deploy data model into a relational database

## **1.4 Research Significance**

With the outcome of this research, a brain disease oriented database will be created with a collection of data that is useful for researchers, medical professional and general public. The creation of BDDDB will increase the awareness and the dissemination of information regarding brain diseases among different segments of the society.

## **1.5 Work Scope**

The database will be covering 62 brain-associated major diseases with all the data sourced from scientific peer-reviewed literatures and established scientific

databases. The database usability will be designed based on the requirements of Malaysian and validated by Malaysian neuropsychiatric professional.

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