

# TABLE OF CONTENTS

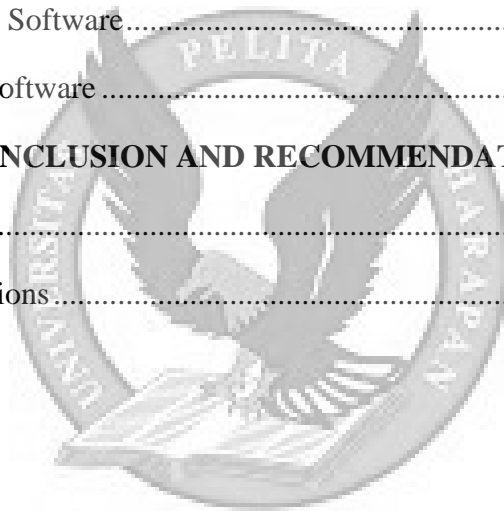
<b>COVER</b>	
<b>ORIGINALITY STATEMENT OF THE THESIS</b>	
<b>THESIS SUPERVISOR’S APPROVAL</b>	
<b>THESIS EXAMINATION COMMITTEE</b>	
<b>ABSTRACT</b> .....	v
<b>ABSTRAK</b> .....	vi
<b>ACKNOWLEDGEMENTS</b> .....	vii
<b>TABLE OF CONTENTS</b> .....	ix
<b>LIST OF FIGURES</b> .....	xiv
<b>LIST OF ABBREVIATIONS</b> .....	xix
<b>CHAPTER I INTRODUCTION</b> .....	<b>1</b>
1.1 Background .....	1
1.2 Problem Identification .....	5
1.3 Limitation of The Study .....	6
1.4 Problem Statement .....	8
1.5 Research Purpose .....	9
1.6 Research Objectives .....	10
1.7 Writing Structure .....	12
<b>CHAPTER II LITERATURE STUDY</b> .....	<b>15</b>
2.1 Log Analysis .....	15
2.1.1. Event Log Analyser .....	16
2.1.2. YARA Rules .....	18
2.1.3. Clustering Log Analysis .....	19
2.1.4. Thor Lite Scanner .....	20

2.2. Static Malware Analysis .....	20
2.3. Dynamic Malware Analysis.....	22
2.4. Hybrid Malware Analysis .....	24
2.5. SQL Injection Logs .....	25
2.5.1 Cross Site Scripting.....	26
2.5.2 Directory Traversal .....	27
2.5.3 Malicious URL Request.....	29
2.6. Malware entropy analysis .....	26
2.7. Code Cross-Reference Malware Analysis .....	32
2.7.1. IDA View-A Analysis.....	33
2.7.2 virustotal.com.....	33
2.7.3. Hybrid-analysis.com .....	36
2.7.4. Salt in Hash Strengthenin.....	37
2.7.5. MD5 (Message Digest Algorithm 5) .....	37
2.7.6. Distribution of File Extensions .....	40
2.7.7. Trojan Backdoor .....	40
2.7.8. Online Gambling.....	42
2.7.9. Malware Detection and Scoring.....	43
<b>CHAPTER III RESEARCH METHODOLOGY .....</b>	<b>47</b>
3.1. Stage Methodology .....	47
3.2. Data Collection.....	53
3.3. Tools and Methodology .....	58
a. Thor Lite Scanner.....	58
b. IDA Pro .....	56
c. VirusTotal.com.....	60
c. Hybrid-Analysis.com .....	62

d.Entrophy Analysis using IDAtropy plugin .....	63
3.4. Methodology .....	65
3.4.1.Clustering Log Analysis.....	65
3.4.1.1. SQL Injection Logs Analysis .....	66
3.4.1.2. Directory Traversal Logs Analysis.....	68
3.4.1.3. Malicious URL Request Logs Analysis .....	70
3.4.1.4 Cross-Site Scripting (XSS) Log Analysis .....	73
3.4.2. Static Analysis .....	75
3.4.3. Dynamic analysis .....	77
3.4.4. Hybrid Analysis .....	78
3.4.5. The Cross-Reference and Code Analysis.....	80
3.4.6.Entropy Analysis.....	83
3.5. Penetration Test.....	84
3.5.1. Stages of a penetration test using Burp Suite.....	84
3.5.2. Stages of a penetration test using Zed Attack Proxy (ZAP) .....	86
3.5.3 Stages of a penetration test using Acunetix .....	88
<b>CHAPTER IV RESEARCH RESULTS AND DISCUSSION .....</b>	<b>86</b>
4.1. Malware Distribution .....	90
4.2. Clustering Types of Attacks by Analyzing Server Logs.....	99
4.2.1. SQL Injection.....	100
4.2.2. Cross site scripting .....	110
4.2.3 Directory Traversal .....	118
4.2.4. Malicious URL Request.....	123
4.3. Analysis Malicious Files .....	132
4.3.1. Static Analysis .....	132
a.File Name : Cina.php .....	132

b.File Name : js-site.web.php .....	138
c.File Name : nez.phtml .....	139
d.File Name : o.php.....	140
e.File Name : bash.alfa.....	142
f.File Name : perl.alfa .....	143
g.File Name : py.alfa.....	145
4.3.2. Dynamic Analysis .....	147
a.File Name : Cina.php .....	147
b.File Name : js-site.web.php .....	150
c.File Name : nez.phtml .....	152
d.File Name : o.php.....	155
e.File Name : bash.alfa.....	158
f.File Name : perl.alfa .....	161
g.File Name : py.alfa.....	162
4.3.3. Hybrid Analysis .....	165
a.File Name : Cina.php .....	165
b.File Name : js-site.web.php .....	166
c.File Name : nez.phtml .....	167
d.File Name : o.php.....	168
e.File Name : bash.alfa.....	169
f.File Name : perl.alfa .....	170
4.3.4. Analyzing Code and Functions .....	171
a.File Name : Cina.php .....	171
b.File Name : js-site.web.php .....	177
c.File Name : nez.phtml .....	180
d.File Name : o.php.....	181

e.File Name : bash.alfa.....	187
f.File Name : perl.alfa .....	192
g.File Name : perl.alfa .....	195
4.3.5. Entropy Analysis.....	197
a.File Name : Cina.php .....	197
b.File Name : js-site.web.php .....	199
c.File Name : nez.phtml .....	200
d.File Name : o.php.....	202
e.File Name : bash.alfa.....	204
f.File Name : perl.alfa .....	206
4.3.6. Penetration Test .....	208
a.Zed Attck Proxy (ZAP).....	208
b.ACUNETIX Software.....	211
c.Burp Suite Software.....	215
<b>CHAPTER V CONCLUSION AND RECOMMENDATION.....</b>	<b>219</b>
5.1. Conclusion .....	219
5.2. Recommendations.....	221
<b>REFERENCES</b>	



## LIST OF FIGURES

Figure 1. 1 Websites that have been infiltrated with online gambling content.....	2
Figure 1. 2 Number and Value of Online Gambling Transactions (2017-2022) .....	3
Figure 1. 3 Website that has been infiltrated with online gambling content.....	4
Figure 1. 4 Research Flowchart on the Issue of Online Gambling Trojans.....	10
Figure 1. 5 Research Objectives Flowchart .....	11
Figure 1. 6 Stage Methodology .....	49
Figure 2. 1 The display of Application process .....	13
Figure 3. 1 Data Collection phase.....	50
Figure 3. 2 Variety of tools .....	52
Figure 3. 3 Analysis stages.....	53
Figure 3. 4 Penetration Testing .....	56
Figure 3. 5 Apanel Dashboard .....	56
Figure 3. 6 Flow Chart Log Analysis.....	59
Figure 3. 7 Flow Chart IDA Pro and Hex View .....	60
Figure 3. 8 Flow Chart Virus Total Usage.....	58
Figure 3. 9 Flow Chart Analyse malware using Hybrid-Analysis.com.....	63
Figure 3. 10 Flow Chart Entrophy Analysis using IDAtropy .....	65
Figure 3. 11 Flow Chart Methodology Log Analysis .....	66
Figure 3. 12 Flow Chart Methodology Log Analysis .....	68
Figure 3. 13 Flow Chart Methodology Directory Traversal Logs Analysis .....	70
Figure 3. 14 Flow Chart Methodology Directory Traversal Logs Analysis .....	72
Figure 3. 15 Flow Chart Methodology Cross-Site Scripting (XSS) Log Analysis....	75
Figure 3. 16 Flow Chart Static Analysis Methodology .....	77
Figure 3. 17 Flow Chart Hybrid Analysis Methodology .....	80
Figure 3. 18 Flow Chart Hybrid Analysis Methodology .....	83
Figure 3. 19 Flow Chart Entropy Analysis .....	84
Figure 3. 20 Flow Chart penetration test using Burp Suite.....	86
Figure 3. 21 Flow Chart penetration test using using Zed Attack Proxy (ZAP).....	87
Figure 3. 22 Flow Chart penetration test using using Acunetix.....	89
Figure 4. 1 Histogram MD5 Hashes and Score Distribution .....	90

Figure 4. 2	Distribution of Malware Score .....	91
Figure 4. 3	Distribution of file extensions .....	92
Figure 4. 4	Distribution of MD5 hash repeated .....	93
Figure 4. 5	Scatter Plot Cluster Base in Scores of malware files.....	94
Figure 4. 6	Directory infiltrated by an online gambling backdoor .....	95
Figure 4. 7	Directory view infiltrated with a script improving its ranking .....	96
Figure 4. 8	Contents of Folder infiltrated php extension gambling content files ..	96
Figure 4. 9	Display of a directory infiltrated by a backdoor trojan.....	97
Figure 4. 10	Backdoor script display .....	97
Figure 4. 11	Backdoor script display .....	98
Figure 4. 12	htaccess display script file that has been modified by attacker .....	98
Figure 4. 13	Percentage IP address SQL Injection Logs .....	100
Figure 4. 14	Sactter Plot Transferred Bytes VS Status Code.....	101
Figure 4. 15	Comparison of the number of HTTP requests with GET and POST .	103
Figure 4. 16	Number of HTTP status codes.....	111
Figure 4. 17	Distribution of HTTP status codes .....	112
Figure 4. 18	Distribution of HTTP request types.....	115
Figure 4. 19	Precentage Directory Traversal Pie Chart .....	116
Figure 4. 20	The number of HTTP requests associated with various IP addresses	119
Figure 4. 21	Distribution of HTTP status codes in logs.....	119
Figure 4. 22	Comparing the number of GET and POST requests .....	120
Figure 4. 23	amount of data transferred (in bytes).....	121
Figure 4. 24	The directory suspected to be compromised by malware.....	128
Figure 4. 25	Directory suspected to be compromised by malware .....	129
Figure 4. 26	user interface of the malware.....	145
Figure 4. 27	The user interface of the malware .....	148
Figure 4. 28	Directory suspected to be compromised by malware .....	149
Figure 4. 29	VirusTotal Graph from file nez.phtml .....	150
Figure 4. 30	The user interface of the malware .....	152
Figure 4. 31	nez,phtml in directory web server .....	153
Figure 4. 32	The user interface of the malware .....	153

Figure 4. 33 file o.php in directory webserver .....	156
Figure 4. 34 VirusTotal Graph from file bash.alfa.....	156
Figure 4. 35 Malware bash.alfa in directory ALFA_DATA.....	157
Figure 4. 36 bash.alfa files in Directory web server .....	157
Figure 4. 37. VirusTotal Graph from file perl.alfa.....	158
Figure 4. 38 perl.alfa in directory web server .....	159
Figure 4. 39 VirusTotal Graph from file py.alfa.....	160
Figure 4. 40 . Malware py.alfa file in directory .....	162
Figure 4. 41 The scan results for the 'cina.php' file on www.hybrid-analysis.com	162
Figure 4. 42 The scan results for the 'cina.php' file on www.hybrid-analysis.com	163
Figure 4. 43T Scan results for the 'cina.php' file on www.hybrid-analysis.com .....	164
Figure 4. 44 The scan results for the 'cina.php' file on www.hybrid-analysis.com .	165
Figure 4. 45 The scan results for the 'cina.php' file on www.hybrid-analysis.com	166
Figure 4. 46 The scan results for py.alfa file on www.hybrid-analysis.com .....	167
Figure 4. 47 The IDA View-A interface of the o.php.....	168
Figure 4. 48 .The Hex View-1 display of the o.php.....	171
Figure 4. 49 .The IDA View-A interface of the 'cina.php' file .....	174
Figure 4. 50 The Hex View-1 display of the js-site.web.php .....	175
Figure 4. 51 The IDA View-A interface of the nez.phtml file.....	177
Figure 4. 52 The Hex View-1 display of the nez.phtml file .....	177
Figure 4. 53 IDA View-A interface of the o.php .....	178
Figure 4. 54 The Hex View-1 display of the o.php.....	181
Figure 4. 55 The IDA View-A interface of the bash.alfa file .....	184
Figure 4. 56 The Hex View-1 display of the bash.alfa file .....	186
Figure 4. 57 The IDA View-A interface of the perl.alfa.....	188
Figure 4. 58 The Hex View-1 display of the perl.alfa .....	189
Figure 4. 59 The IDA View-A interface of the py.alfa.....	191
Figure 4. 60 The Hex View-1 display of the py.alfa.....	192
Figure 4. 61 Entropy level graph of the 'cina.php' file .....	193
Figure 4. 62 Graphical representation of the frequency distribution byte values	194
Figure 4. 63 The entropy level graph of the js-site.web.php.....	195
Figure 4. 64 Graphical frequency distribution byte values file js-site.web.php ...	199



Figure 4. 65 The Hex View-1 display of nez.phtml file .....	200
Figure 4. 66 The entropy level graph of the nez.phtml file.....	197
Figure 4. 67 The entropy level graph of the o.php.....	198
Figure 4. 68 Graphical frequency distribution byte values file o.php.....	203
Figure 4. 69 .The entropy level graph of the bash.alfa file .....	204
Figure 4. 70 Graphical frequency distribution byte values bash.alfa file .....	205
Figure 4. 71 The entropy level graph of the perl.alfa.....	206
Figure 4. 72 . Graphical frequency distribution byte values file perl.alfa .....	207
Figure 4. 73 Burp Suite software Before and After Apache WAF enable.....	210



## LIST OF TABLES

Table 4. 1. Apache Access Logs - SQL Injection .....	104
Table 4. 2 . Apache Access Logs - SQL Injection .....	107
Table 4. 3 . Apache Access Logs - SQL Injection .....	109
Table 4. 4 Apache Access Logs - SQL Injection .....	110
Table 4. 5 Apache Access Logs - SQL Injection .....	109
Table 4. 6 Apache Access Logs - SQL Injection .....	110
Table 4. 7 Cross Site Scripting (XSS).....	113
Table 4. 8 Cross Site Scripting (XSS).....	114
Table 4. 9 Directory Traversal .....	117
Table 4. 10 Directory Traversal .....	122
Table 4. 11. Malicious URL Request.....	124
Table 4. 12 Malicious URL Request.....	124
Table 4. 13 . Malicious URL Request.....	125
Table 4. 14 Malicious URL Request.....	126
Table 4. 15 Malicious URL Request.....	126
Table 4. 16 Malicious URL Request.....	127
Table 4. 17 Malicious URL Request.....	127
Table 4. 18 Results of the file cina.php scan on VirusTotal.com .....	131
Table 4. 19 Results of the file js-site.web.php scan on VirusTotal.....	134
Table 4. 20 Results of the file nez.phtml scan on VirusTotal.com .....	135
Table 4. 21 Results of the file o.php scan on VirusTotal.com .....	137
Table 4. 22 Results of the file bash.alfa scan on VirusTotal.com.....	139
Table 4. 23 Results of the file perl.alfa on VirusTotal.com .....	141
Table 4. 24 Results of the file py.alfa scan on VirusTotal.com .....	143
Table 4. 25 Network Network Communication from malware .....	161
Table 4. 26 Results of Penetration Test using Zed Attack Proxy (ZAP) .....	204
Table 4. 27 ACUNETIX Scan Results.....	205
Table 4. 28 Burp Suit Penetration Test Result.....	208