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DEAD FORENSIC ANALYSIS OF QUTEBROWSER AND LIBREWOLF BROWSERS USING THE NIST 800-86 METHOD

Fajar Al Rasyid[1], Bita Parg Zen[*2]

[1,2]Informatics Engineering, Institut Teknologi Telkom Purwokerto, Indonesia
Email: [1]18102012@ittelkom-pwt.ac.id, [2]bita@ittelkom-pwt.ac.id

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Abstract

A browser is software used to access web pages to obtain clear and readable information. Information resources are identified by a Uniform Resource Identifier (URI) and can be web pages, images, videos, or other content. When a browser user engages in online activities, they usually leave traces on the device such as history, cookies, cache files, and even emails and passwords. Such traces can usually help users access a website or input something, such as emails and passwords. The purpose of this research is to obtain digital evidence in the form of a cache on the hard disk in the Librewolf and Qutebrowser browsers. In this study, researchers used the National Institute of Standards and Technology (NIST) 800-86 method which consists of four stages, namely collection, examination, analysis, and reporting. which focuses on the Qutebrowser and LibreWolf browsers. The results obtained from this study were found to be 21 caches, 2 Sessions, 6 Cookies, 8 Network Persistent State, 9 QuotaManager, 11 IndexedDB, 24 LevelDB, 48 Cache Storage, 14 Favicons, 3 History, 6 Database, 3 StartupCache, 4 Alternate Services, 6 Content-Pref, Notification amounted to 1, Permission amounted to 7, Service Worker amounted to 6, SiteSecuristyServiceState amounted to 7, Webappstore amounted to 8, Sessionstore-Backups amounted to 5, Storage amounted to 47 NIST 800-86 method can be properly used in the acquisition of digital evidence and the most crucial data obtained in the Librewolf browser on the telegram and whatsapp sites.

Keywords: *Browser, Dead Forensic, LibreWolf, NIST 800-86, QuteBrowser*.

1. INTRODUCTION

In the era of rapid development of information technology, browsers are now applications that must be installed on desktop and mobile devices, even TVs and refrigerators are now also integrated with browsers. A browser is software used to access web pages to obtain clear and easy-to-read information. Information resources are identified by a Uniform Resource Identifier (URI) and can be web pages, images, videos, or other content[1]. The activity of using the browser itself is called browsing, usually browser users use the browser to access web pages such as shopping online, interacting with people using social media, accessing email or uploading and downloading files [2].

Qutebrowser and LibreWolf are two examples of existing browsers. Qutebrowser is an open-source browser that focuses on using the keyboard[3]. While LibreWolf is a browser produced by the open-source software community that focuses on security and privacy [4].

When a browser user performs activities in cyberspace, the browser user usually leaves traces on the device such as history, cookies, cache files, even email addresses and passwords[5]. Traces like this can usually help users access a website or input something, such as email and password [6]. If information such as emails or passwords are too open or can be easily accessed by others, there is a possibility of misuse of personal data such as copying information on ATM cards (skimming) where the perpetrators of email and password abuse can withdraw funds elsewhere[7]. It will lead to Cybercrime, cybercrime itself is a crime committed using computer networks or digitally by misusing digital technology as the main crime tool[8].

This can be used as an important part of digital forensics as digital evidence. In general, digital forensics itself is a scientific process or to collect, analyze and present evidence to assist in the law enforcement process to solve digital crime cases[9]. Digital Forensics is a branch of forensic science that focuses on evidence derived from computers or digital sources such as photo files, flash drives, hard disks, emails, passwords, log files, data packets in computer networks[10]. One example of a digital forensic technique is dead forensic, dead forensic itself is a technique where the acquisition of digital evidence is acquired on an operating system where the digital evidence to be acquired is permanently stored in storage such as a solid slate drive or hard disk [11].

In the focus of the problem above, the researcher decided to analyze dead forensics on browsers with the NIST 800-86 method which focuses on the Qutebrowser and LibreWolf browsers.

So, with this research, it can be used as a benchmark to determine the level of security and find out what crucial data is obtained through the Qutebrowser and LibreWolf browsers.

2. RESEARCH METHOD

2.1. Research Flow Chart

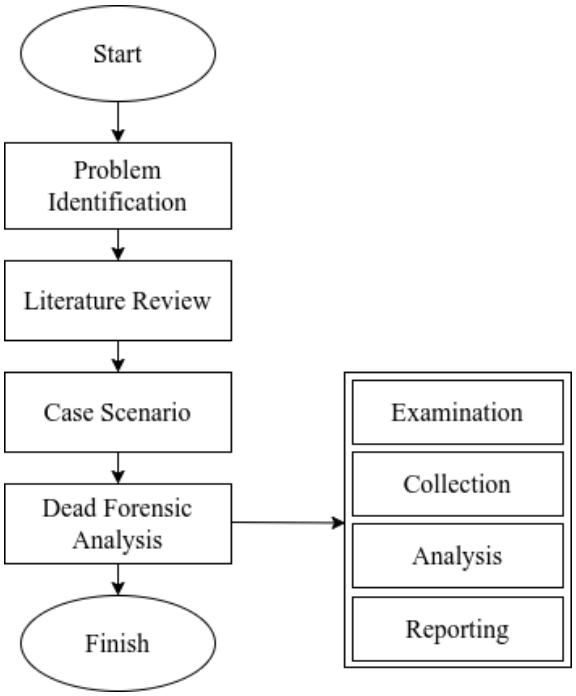

Figure 1. Research Flow Chart

2.1.1. Problem Identification

At this stage, the existing problems are identified, namely how to perform dead forensic analysis on the Librewolf and Qutebrowser browsers to obtain digital evidence.

2.1.2. Literature Review

This research stage is to collect data related to the problem in question. Literature study is carried out after the identification process as a reference from related research and journals to assist researchers in completing the research.

2.1.3. Case Scenario

The scenario in this study was created by researchers to carry out the research process. In this scenario, it begins with the acquisition of a user's computer that has been used to access the browser. After that, the acquisition and clone of data from the computer user's flashdisk is carried out. then after the acquisition process is complete, the data analysis process is carried out on the acquired flashdisk[12].

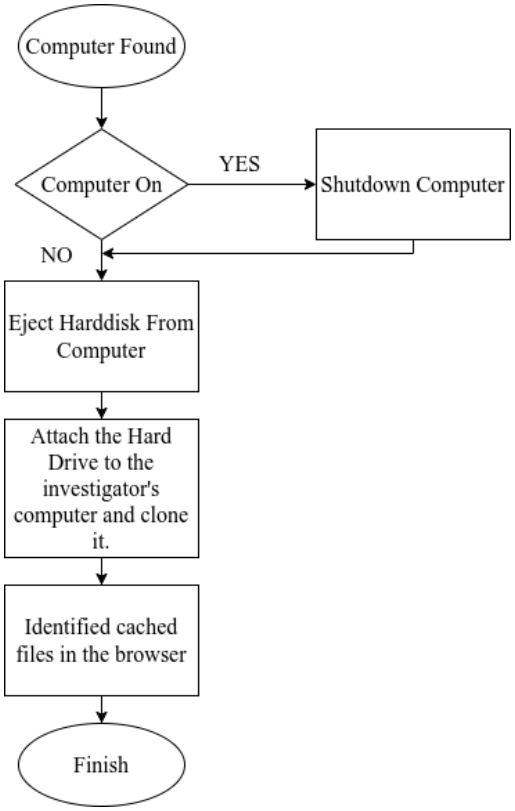

Figure 2. Case Scenario

2.1.4. Dead Forensic Analysis

Dead Forensic is a digital evidence acquisition technique that requires data that is permanently stored on a storage hardware device such as a hard disk . Dead forensic techniques allow investigators to recover deleted or corrupted files from disk drives and other storage media.[13] After performing data acquisition using the dead forensic method, the next step is data anlaysing using the National Institute of Standards and Technology (NIST) 800-86 method.At this stage the first NIST 800-86 is Collection, which is the activity of collecting digital data evidence. In this scenario, digital evidence in the form of cached data comes from the browser used to access social media sites[14]. Next is the examination stage, which is the stage of activity to process the data that has been obtained. At this stage the data that has been found will be examined using Autopsy. After getting the file results obtained through Autopsy[15]. At the analysis stage, a detailed analysis will be carried out to obtain information in accordance with the scenario that has been made[16]. The last stage will be reporting, reporting is stage for reporting the results of analysis and examination from the previous stage. These results will be used as reporting what evidence is obtained from this research[17].

3. RESULT

3.1. Collection

At the collection stage, researchers collect tools and materials such as the QuteBrowser and Librewolf

browsers and Autopsy as forensic tools. forensic tools will be used to search for digital evidence stored on a flash drive. After that the researcher cloned the data contained on the flashdisk in a dead forensic manner. after that the digital evidence obtained will be recognized using forensic tools with predetermined parameters. Below is an advanced description of the tools used for digital evidence collection:

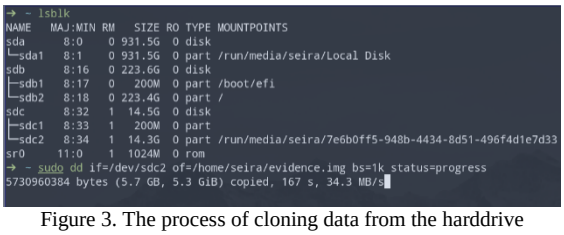

Figure 3. The process of cloning data from the harddrive

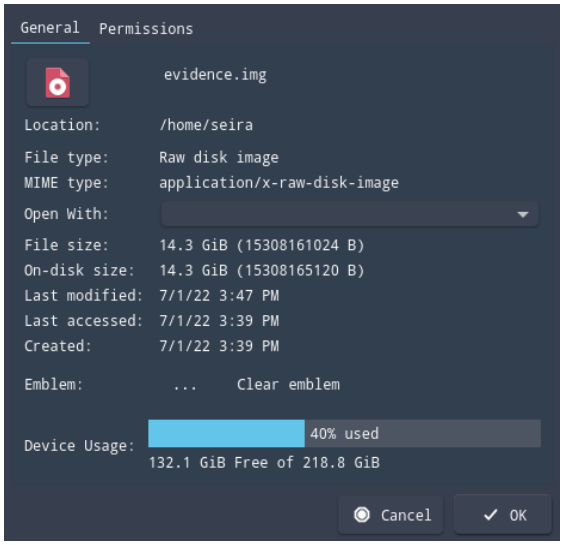

Figure 4. Results of evidence files that have been cloned.

3.2. Examination

At the examination stage, an investigation and data search will be carried out using the Autopsy tool, using this tool, data stored in the flashdisk clone that has been cloned by the researcher will be searched by analyzing each browser that has been determined.

3.2.1. QuteBrowser Examination

Table 1. QuteBrowser Examination

Storange Location	File Name	Details Explanation
/1/home/vengenz/.cache/qutebrowser/webengine/Cache/	1. 035316b882ed2ccc_0 2. 08a47460b3eac7ba_0 3. 0f146dfbcd9da15c_0 4. 742cda28ea6ec9b6_0 5. f824eee411acebe8_0 6. f1797e4c46da70b1_0 7. e711509bc830d475_0	1. A cache that contains a URL that leads to an image on the twitter site 2. A cache that contains a URL that leads to an image on the Facebook site 3. A cache that contains a URL that leads to an zz image on the twitter site 4. A cache that contains a URL that leads to an emoji image on the whatsapp site 5. A cache that contains a URL that leads to an emoji image on the whatsapp site
/1/home/vengenz/.local/share/qutebrowser/	1. cmd-history 2. history.sqlite 3. history.sqlite-wal	1. A log file that contains a history of visits to Facebook, Instagram, Twitter, WhatsApp, Telegram, YouTube, and Instagram sites 2. A sqlite database that contains a history of visits to facebook, instagram, twitter, whatsapp, telegram, youtube, and instagram sites
/1/home/vengenz/.local/share/qutebrowser/sessions	1. _autosave.yml	1. A new autosave file that contains session URL visits to facebook, instagram, twitter, whatsapp, telegram, youtube, and instagram sites
/1/home/vengenz/.local/share/qutebrowser/sessions/before-qt-515/	2. _autosave.yml	2. In the form of an old autosave file that contains session URL visits to facebook, instagram, twitter, whatsapp, telegram, youtube, and instagram sites
/1/home/vengenz/.local/share/qutebrowser/webengine/	3. .org.chromium.Chromium.z5Vh45	3. A file containing a URL that shows visits to Facebook, Instagram, Twitter, WhatsApp, Telegram, YouTube, and Instagram sites
/1/home/vengenz/.local/share/qutebrowser/webengine/Cookies	1. Cookies 2. Cookies 3. Cookies 4. Cookies 5. Cookies 4. Cookies	1. A Cookies file that contains a URL to Facebook DNS 2. A Cookies file that contains a URL to the Twitter DNS 3. A Cookies file that contains a URL to Telegram DNS
/1/home/vengenz/.local/share/qutebrowser/webengine/NetworkPersistentState	1. Network Persistent State 2. Network Persistent State 3. Network Persistent State 4. Network Persistent State	1. A file containing a URL that shows visits to Facebook, Instagram, Twitter, WhatsApp, Telegram, YouTube, and Instagram sites 2. A Cookies file that contains a URL to Facebook DNS 3. A Cookies file that contains a URL to the Twitter DNS

Storange Location	File Name	Details Explanation
/1/home/vengenz/.local/share/qutebrowser/webengine/QuotaManager	1. QuotaManager 2. QuotaManager 3. QuotaManager 4. QuotaManager 5. QuotaManager	1. A file that contains a URL to Facebook DNS 2. A file that contains a URL to the Twitter DNS 3. A file that contains a URL to Telegram DNS 4. A file that contains a URL to the Instagram DNS 5. A file that contains a URL to the gmail DNS
/1/home/vengenz/.local/share/qutebrowser/webengine/QuotaManager-journal	1. QuotaManager-journal	1. A file that contains a URL to DNS whatsapp, instagram, gmail, facebook, telegram, twitter
/1/home/vengenz/.local/share/qutebrowser/webengine/File System/Origins/	1. 000003.log	1. A log file containing the whatsapp URL
/1/home/vengenz/.local/share/qutebrowser/webengine/IndexedDB/https_mail.google.com_0.indexeddb.leveldb/	1. 000037.ldb	1. A database file that contains a URL to the Gmail DNS
/1/home/vengenz/.local/share/qutebrowser/webengine/IndexedDB/https_twitter.com_0.indexeddb.blob/1/00/	1. 7	1. A file that contains a web URL listed on Twitter.
/1/home/vengenz/.local/share/qutebrowser/webengine/IndexedDB/https_twitter.com_0.indexeddb.leveldb/	1. 000003.log	1. A log file containing the URL to the Twitter DNS
/1/home/vengenz/.local/share/qutebrowser/webengine/IndexedDB/https_web.whatsapp.com_0.indexeddb.leveldb/	1. 000411.ldb 2. 000707.ldb 3. 001015.log	1. A file containing the download URL on the whatsapp site 2. A file containing the user's phone number on the whatsapp site 3. A file containing the phone number of the user's contact on the whatsapp site
/1/home/vengenz/.local/share/qutebrowser/webengine/IndexedDB/https_www.facebook.com_0.indexeddb.leveldb/	1. 000013.ldb	1. A file that contains the user id of the facebook user
/1/home/vengenz/.local/share/qutebrowser/webengine/IndexedDB/https_www.instagram.com_0.indexeddb.blob/1/00/	1. 35 2. 36	1. A file containing the username of Instagram users 2. A file containing the username of Instagram users
/1/home/vengenz/.local/share/qutebrowser/webengine/IndexedDB/https_www.instagram.com_0.indexeddb.leveldb/	1. 000003.log	1. A log file containing the username of Instagram users
/1/home/vengenz/.local/share/qutebrowser/webengine/IndexedDB/https_www.youtube.com_0.indexeddb.leveldb/	1. 000074.ldb	1. A database file that contains a URL to YouTube DNS
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/0bf6ab7f94a21cdc9c1649f884333ec20f40a544/50ef8243-a1ad-4e40-97ef-248de66f674b/	1. 3b839d1486c696fc_0 2. a034088ecd4af689_0 3. e2549db5b87cda28_0 4. e49ed4f0eb31b1b0_0	1. A file that contains a URL to whatsapp 2. A file that contains a whatsapp favicon URL 3. A file that contains a URL to the whatsapp background image 4. A file that contains a URL to the whatsapp background image
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/0bf6ab7f94a21cdc9c1649f884333ec20f40a544/81911eb7-ee80-4fa9-b40e-2c88053666ac/	1. 019025487f58206c_0 2. 0af9d1009189ecad_0 3. 0af9d1009189ecad_1 4. 15b4f8770bbaff5f_0 5. 19aa9078b8bb4bed_0 6. 19aa9078b8bb4bed_1 7. 29cc20b5cb815f8c_0 8. 34fb308d82ad69bd_0 9. 37c974137c9cc9a0_0 10. 37c974137c9cc9a0_1	1. A file that contains a URL that forms a QR code on WhatsApp 2. A file that contains a URL to whatsapp 3. A file that contains a URL to whatsapp 4. A file that contains a URL to whatsapp 5. A file that contains a URL to whatsapp 6. A file that contains a URL to whatsapp 7. A file that contains a URL to whatsapp 8. A file that contains a URL to whatsapp 9. A file that contains a URL to whatsapp 10. A file that contains a URL to whatsapp 11. A file that contains a URL to whatsapp 12. A file that contains a URL to whatsapp 13. A file that contains a URL to whatsapp 14. A file that contains a URL to whatsapp 15. A file that contains a URL to whatsapp
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/0bf6ab7f9	1. index.txt	1. A file that contains a URL to whatsapp

Storange Location	File Name	Details Explanation
4a21cdc9c1649f884333ec20f40a544/		
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/2348e52d6de9218df880d9a88ad6a5d8c2c9555c/	1. index.txt	1. A file that contains a URL to Instagram
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/2348e52d6de9218df880d9a88ad6a5d8c2c9555c/d2865551-f465-4c57-bc66-7e86e7b54729	1. b23c6762cf5da770_0	1. A file that contains a URL to Instagram
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/2348e52d6de9218df880d9a88ad6a5d8c2c9555c/e1c19ca9-25a6-4a8b-857b-c2d4081dad2f	1. 8f115e7edf3edaea_0 2. 8f115e7edf3edaea_0	1. A file that contains a URL to Instagram and the user agent of the browser used 2. A file that contains the userid of the Instagram user
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/379f1cbab5b08b6fc9e08681e42d8be311441c88/	1. index.txt	1. A file that contains a URL to youtube
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/379f1cbab5b08b6fc9e08681e42d8be311441c88/c9db4c2c-4565-4751-8be8-1cc616fafcf6/	1. 03fd640e820a484b_0 2. 03fd640e820a484b_1 3. 04c1c8a8acbe0dcd_0 4. 04c1c8a8acbe0dcd_1 5. 0634a01b056cabe1_0	1. A file that contains a URL to youtube 2. A file that contains a URL to youtube 3. A file that contains a URL to youtube 4. A file that contains a URL to youtube 5. A file that contains a URL to youtube
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/579544fd7d0441717f082c9eb123588966aa57ac	1. index.txt	1. A text file that contains a URL to gmail
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/579544fd7d0441717f082c9eb123588966aa57ac/1f60e163-350b-45a7-8255-356686a9ef7d	3. 072112b079943d3a_0 4. 072112b079943d3a_1 5. 09963df21138c9a6_0 6. 0cd051634a8e554e_0 7. 0dd20fd2f4e78423_0	3. A file that contains a URL to gmail 4. A file that contains a URL to gmail 5. A file that contains a URL to gmail 6. A file that contains a URL to gmail 7. A file that contains a URL to gmail
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/579544fd7d0441717f082c9eb123588966aa57ac/3c419b4a-3147-42d2-91b4-29f68594b419/	1. 28c7241e632cff34_0 2. 72848c0ca515f8c5_0 3. 8fa1800445afaada_0	1. A file that contains a URL to gmail 2. A file that contains a URL to gmail 3. A file that contains a URL to gmail
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/579544fd7d0441717f082c9eb123588966aa57ac/f0dee91a-08f5-4964-b1fb-190eba7316fa/	1. 29213d2ab33b53bc_0	1. A file that contains a URL to gmail
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/8f7abdeb3486c1b8780fede76afc20e044eff1b5/	1. index.txt	1. A text file containing a URL to twitter
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/8f7abdeb3486c1b8780fede76afc20e044eff1b5/44a7b6b7-e347-4c2e-8ffa-8ef07918386d/	1. af47be93e4c33dc6_0	1. A file that contains a URL to twitter
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/8f7abdeb3486c1b8780fede76afc20e044eff1b5/da0c3481-3ac2-49a6-9110-9aa8a10ca9e6/	1. ff9e67c725073294_1 2. ff9e67c725073294_0 3. fd21a4e85ffe41fa_1 4. fd21a4e85ffe41fa_0 5. fcf63b5f2ecb7915_1	1. A file that contains a URL to twitter 2. A file that contains a URL to twitter 3. A file that contains a URL to twitter 4. A file that contains a URL to twitter 5. A file that contains a URL to twitter
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/579544fd7d0441717f082c9eb123588966aa57ac/1f60e163-350b-45a7-8255-356686a9ef7d	1. index.txt	1. A file that contains a URL to telegram

Storange Location	File Name	Details Explanation
tebrowser/webengine/Service Worker/CacheStorage/ba00623a413aef1be0c65618db85f0b8176e803d/		
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/ba00623a413aef1be0c65618db85f0b8176e803d/006173c9-415e-4798-834e-933d59224ff2/	1. d7eefea52311173e_0	1. A file that contains a URL to telegram
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/ba00623a413aef1be0c65618db85f0b8176e803d/010c941d-1336-4a97-9fbc-0be70d213626/	1. e7afdaff71c404ef_0	1. A file that contains a URL to telegram
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/ba00623a413aef1be0c65618db85f0b8176e803d/0198f02e-6094-4cbb-a69f-92da2d0019b8/	1. f6cb8956dd7533a0_0	1. A file that goes to the telegram favicon URL
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/ba00623a413aef1be0c65618db85f0b8176e803d/040ef020-2212-40de-85c3-ca2f714d8d2f/	1. 59312eae6d0ae50a_0	1. A file that goes to the telegram favicon URL
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/ba00623a413aef1be0c65618db85f0b8176e803d/06c8a98b-6982-4273-8a38-480c68f25b7e/	1. 8c6fe59d9b99139d_0 2. 8c6fe59d9b99139d_1	1. A file that contains a URL to telegram A file that contains a URL to telegram
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/CacheStorage/ba00623a413aef1be0c65618db85f0b8176e803d/29b3d504-60bd-493a-9fb3-9e8387f615cd/	1. 65ad634a92ada8b0_0	1. A file that contains a URL to telegram
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/Database/	1. 000003.log 2. 000003.log 3. 000003.log 4. 000003.log 5. 000003.log 6. 000003.logz	1. A file containing the URL to the Telegram DNS 2. A file that contains a URL to the gmail DNS 3. A file containing the URL to the Twitter DNS 4. A file that contains a URL to the Instagram DNS 5. A file that contains a URL to WhatsApp DNS 6. A file that contains a URL to YouTube DNS
/1/home/vengenz/.local/share/qutebrowser/webengine/Service Worker/ScriptCache/	1. 0b3d59c1b2221f76_0 2. 2e6c20ddc8de0d45_1 3. 5e8338b7d96bb016_1 4. 7ac4c22e06202ba7_1 5. 9ff026236b3a5017_1 6. a46fc2cb518ae280_1 7. ac45ef07f88a0c2d_1	1. A file containing the URL to the Telegram DNS 2. A file containing the URL to the Twitter DNS 3. A file that contains a URL to YouTube DNS 4. A file that contains a URL to the Facebook DNS 5. A file that contains a URL to WhatsApp DNS 6. A file that contains a URL to the gmail DNS 7. A file that contains a URL to YouTube DNS
/1/home/vengenz/.local/share/qutebrowser/webengine/Session Storage/	1. 000004.log 2. 000004.log 3. 000004.log 4. 000005.ldb 5. 000005.ldb	1. A file that contains a URL to the Facebook DNS 2. A file that contains a URL to WhatsApp DNS 3. A file that contains a URL to the Instagram DNS 4. A file that contains a URL to the Facebook DNS 5. A file that contains a URL to the gmail DNS

3.2.2. LibreWolf Examination

Table 2. LibreWolf Examination

Storange Location	File Name	Details Explanation
/1/home/vengenz/.cache/librewolf/k41e26jp.default-	1. scriptCache-child-current.bin 2. scriptCac	1. A file that contains a URL to the gmail DNS 2. A file containing the URL to the Twitter DNS 3. A file that contains a

Storange Location	File Name	Details Explanation
release/startupCache/	he-child-current.bin	URL to YouTube DNS
	3. scriptCache-child-current.binz	
/1/home/vengenz/.librewolf/k41e26jp.default-release/	1. addonStartup.json.lz4	1. A file that contains information about the user name using the librewolf browser
	1.	1.
/1/home/vengenz/.librewolf/k41e26jp.default-release/AlternateServices.txt	1. AlternateServices.txt	1. A file that contains a URL to the Facebook DNS
	2. AlternateServices.txt	2. A file that contains a URL to YouTube DNS
	3. AlternateServices.txt	3. A file that contains a URL to the Instagram DNS
	1. AlternateServices.txt	1. A file that contains a URL to WhatsApp DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/content-prefs.sqlite	1. content-prefs.sqlite	1. A file that contains a history of files downloaded from telegram
	2. content-prefs.sqlite	2. A file that contains a history of files downloaded from telegram
	3. content-prefs.sqlite	3. A file that contains a history of files downloaded from telegram
	4. content-prefs.sqlite	4. A file that contains a history of files downloaded from telegram
	5. content-prefs.sqlite	5. A file that contains a history of files downloaded from telegram
	6. content-prefs.sqlite	6. A file that contains a history of files downloaded from telegram
/1/home/vengenz/.librewolf/k41e26jp.default-release/cookies.sqlite	1. cookies.sqlite	1. A Cookies file that contains a URL to Facebook DNS
	2. cookies.sqlite	2. A Cookies File that contains a URL to the Twitter DNS
	3. cookies.sqlite	3. A Cookies file that contains a URL to Telegram DNS
	4. cookies.sqlite	4. A Cookies file that contains a URL to the Instagram DNS
	5. cookies.sqlite	5. A Cookies file that contains a URL to the Gmail DNS
	6. cookies.sqlite	1. A Cookies file that contains a URL to YouTube DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/favicons.sqlite	1. favicons.sqlite	1. A database file containing the URL to the twitter favicon
	2. favicons.sqlite	2. A database file containing the URL to the telegram favicon
	3. favicons.sqlite	3. A database file containing the URL to the Instagram favicon
	4. favicons.sqlite	4. A database file that contains a URL to the whatsapp favicon
	5. favicons.sqlite	5. A database file that contains a history of going to Facebook images
	6. favicons.sqlite	6. A database file that contains a history of going to twitter
	7. favicons.sqlite	7. A database file that contains a history of going to Instagram
	8. favicons.sqlite	8. A database file that contains a history of going to Telegram
	9. favicons.sqlite	9. A database file that contains a history of going to youtube
	10. favicons.sqlite	10. A database file that contains a history of going to gmail
	11. favicons.sqlite	11. A database file that contains a history of going to whatsapp
/1/home/vengenz/.librewolf/k41e26jp.default-release/	1. notificationstore.json	1. 1. In the form of notification configuration from the telegram site
/1/home/vengenz/.librewolf/k41e26jp.default-release/permissions.sqlite	1. permissions.sqlite	1. A database file that contains access permissions from the whatsapp site
	2. permissions.sqlite	2. A database file that contains access permissions from the Instagram site
	3. permissions.sqlite	3. A database file that contains access permissions from the telegram site
	4. permissions.sqlite	4. A database file that contains access permissions from the gmail site
	5. permissions.sqlite	5. A database file that contains access permissions from the twitter site
	6. permissions.sqlite	6. A database file that contains access permissions from the facebook site
	7. permissions.sqlite	2. A database file that contains access permissions from the youtube site
/1/home/vengenz/.librewolf/k41e26jp.default-release/serviceworker.txt	1. serviceworker.txt	1. A text file that contains a URL to YouTube DNS
	2. serviceworker.txt	2. A text file containing a URL to Telegram DNS
	3. serviceworker.txt	3. A text file containing the URL to the Twitter

Storange Location	File Name	Details Explanation
	4. serviceworker.txt	DNS 4. A text file that contains a URL to the gmail DNS
	5. serviceworker.txt	5. A text file that contains a URL to WhatsApp DNS
	6. serviceworker.txt	1.
/1/home/vengenz/.librewolf/k41e26jp.default-release/	1. sessionstore.jsonlz4	1. A json file containing the email address used on the gmail site
/1/home/vengenz/.librewolf/k41e26jp.default-release/SiteSecurityServiceState.txt	1. SiteSecurityServiceState.txt	1. A text file containing HSTS supercookies on the Instagram site
	2. SiteSecurityServiceState.txt	2. A text file containing HSTS supercookies on the youtube site
	3. SiteSecurityServiceState.txt	3. A text file containing HSTS supercookies on the telegram site
	4. SiteSecurityServiceState.txt	4. A text file containing HSTS supercookies on the facebook site
	5. SiteSecurityServiceState.txt	5. A text file containing HSTS supercookies on the twitter site
	6. SiteSecurityServiceState.txt	6. A text file containing HSTS supercookies on the whatsapp site
	SiteSecurityServiceState.txt	7. A text file containing HSTS supercookies on the gmail site
/1/home/vengenz/.librewolf/k41e26jp.default-release/webappsstore.sqlite	1. webappsstore.sqlite	1. A database file containing a message from telegram containing a whatsapp group invitation link
	2. webappsstore.sqlite	2. A database file that contains chat number information on WhatsApp
	3. webappsstore.sqlite	3. A database file that contains data information on username, phone number, and name on Telegram
	4. webappsstore.sqlite	4. A database file that contains information on group id and group name on telegram
	5. webappsstore.sqlite	5. A database file containing messages received on a telegram account in the form of an authentication code
	6. webappsstore.sqlite	6. A database file containing messages from a telegram account A YouTube URL
	7. webappsstore.sqlite	7. A database file containing messages from a telegram account
	8. webappsstore.sqlite	8. A database file that contains userid information from a telegram account
/1/home/vengenz/.librewolf/k41e26jp.default-release/sessionstore-backups/	1. previous.jsonlz4	1. A json file that contains a URL to whatsapp DNS
	2. upgrade.jsonlz4-20220603210848	2. A json file that contains the URL to the Facebook DNS
	3. upgrade.jsonlz4-20220603210848	3. A json file that contains the URL to the Twitter DNS
	4. upgrade.jsonlz4-20220603210848	4. A json file that contains a URL to YouTube DNS
	5. upgrade.jsonlz4-20220603210848	5. A json file that contains a URL to Telegram DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++mail.google.com/	1. .metadata-v2/	1. A file that contains a URL to the gmail DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++mail.google.com/cache/	1. caches.sqlite	1. A file that contains a URL to the gmail DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++mail.google.com/idb/	1. 548905059db.sqlite	1. A file that contains a URL to the gmail DNS
	2. 953658429glmaaviyle-ks-w.sqlite	2. A file that contains a URL to the gmail DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++mail.google.com/ls/	1. data.sqlite	1. A file that contains a URL to the gmail DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++twitter.com/	1. .metadata-v2	1. A file that contains a URL to the Twitter DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++twitter.com/cache	1. caches.sqlite	1. A file that contains a URL to the Twitter DNS
/1/home/vengenz/.librewolf/k41	1. 1046228012scyn.sql	1. A file that contains a URL to the Twitter DNS

Storange Location	File Name	Details Explanation
e26jp.default-release/storage/default/https++twitter.com/idb/	ite 2. 1367196241hboerwinzo.sqlite 3. 3619119340leogcaarlof.sqlite	2. A file that contains a URL to the Twitter DNS 3. A file that contains a URL to the Twitter DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++twitter.com/ls/	1. data.sqlite	1. A file that contains a URL to the Twitter DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++web.telegram.org/	1. .metadata-v2	1. A file that contains a URL to Telegram DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++web.telegram.org/cache	1. caches.sqlite	1. A file that contains a URL to Telegram DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++web.telegram.org/idb/	1. 2213921257keeuylva.sqlite 2. 2728594770keeryovtasl-.sqlite	1. A file that contains a URL to Telegram DNS 2. A file that contains a URL to Telegram DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++web.telegram.org/ls/	1. data.sqlite	1. A file that contains a URL to Telegram DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++web.whatsapp.com/	1. .metadata-v2	1. A file that contains a URL to WhatsApp DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++web.whatsapp.com/cache/	1. caches.sqlite	1. A file that contains a URL to WhatsApp DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++web.whatsapp.com/idb/	1.	
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++web.whatsapp.com/ls/	1.	1.
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++www.facebook.com/	1. .metadata-v2/	1. A file that contains a URL to Facebook DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++www.facebook.com/ls/	1. data.sqlite	1. A file that contains the userid of the Facebook user
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++www.instagram.com/	1. .metadata-v2	1. A file that contains a URL to the Instagram DNS
/1/home/vengenz/.librewolf/k41e26jp.default-release/storage/default/https++www.instagram.com/cache/	1. caches.sqlite	1. A file that contains a URL to the Instagram DNS

3.3. Analysis

At the analysis stage, we will analyze the evidence that has been obtained in the previous stages. This research uses autopsy as a digital forensic analysis tool and uses the artix linux rolling release operating system as the operating system, the following are the results of the data analysis that has been obtained.

Table 3 Analysis Result

Browser Name	Disadvantages	Advantages
QuteBrowser	For some social media not found	Found the user's user data, especially the browser cache.
LibreWolf	No cached data found in the browser	Found crusial data in the form of text, phone number, userid in the webappstore file

3.4. Reporting

Reporting is done by explaining the digital evidence that has been obtained previously. With the proof of the digital evidence can be included as follows.

Table 4. Reporting Result

LibreWolf	QuteBrowser
StartupCache Alternate Services Content-Pref Favicon Notification	Cache Sessions Cookies Network Persistent State QuotaManager IndexedDB LevelDB Cache Storage Favicons History Database Session Storage

LibreWolf	QuteBrowser
Permission	
Service Worker	
SiteSecurityServiceStat	
Webappstore	
Sessionstore-Backups	
Storage	

4. DISCUSSION

From the digital evidence acquisition technique with the NIST 800-86 method on the QuteBrowser and Librewolf browsers, digital evidence can be found in the form of telephone numbers, userids, important messages, etc.

In the NIST 800-86 method, there are four stages, namely Collection, Examination, Analysis, and Reporting. At the collection stage, we will collect cache data on librewolf and QuteBrowser browsers. After the collection stage, then the examination stage is carried out, namely the stage where the search and processing of data that has been obtained using the Autopsy tool. Autopsy is used to search for data that has been cloned from a flashdisk, Data search using the Autopsy tool is carried out by opening each folder and sub folder in the specified browser folder.

After searching for digital evidence data, digital evidence such as username, url, phone number, and cache can be found. As in the folder /home/vengenz/. cache/qutebrowser/webengine/Cache/ there is a file called 035316b882ed2ccc_0, the file contains a link to an image on the twitter site.

Next is the analysis stage, which is the stage for analyzing the digital evidence that has been obtained in the previous process. At the last stage is the reporting stage, which is the stage for reporting digital evidence found in this study. Such as digital evidence found on the QuteBrowser browser located at /home/vengenz/.cache/qutebrowser/webengine/Cache/08a47460b3eac7ba_0, and the LibreWolf browser located at /http://ome/vengenz/.cache/librewolf/k41e26jp.default-release/startupCache/ScriptCache-childcurrent.bin.

5. CONCLUSION

After carrying out the stages of analyzing digital evidence with the NIST 800-86 method can result in a large number of examined cahce files, after the examined data from these two browsers is compared, it is found that there is a difference in the amount of crucial data exposed, and results in data results in the form of Cache totaling 21, Sessions totaling 2, Cookies totaling 6, Network Persistent State totaling 8, QuotaManager totaling 9, IndexedDB totaling 11, LevelDB totaling 24, Cache Storage totaling 48, Favicons totaling 14, History is 3, Database is 6, StartupCache is 3, Alternate Services is 4, Content-Pref is 6, Notification is 1, Permission is 7, Service Worker is 6, SiteSecurityServiceState is 7, Webappstore is 8, Sessionstore-Backups is 5, Storage is 47. The most crucial data obtained in the Librewolf browser on the telegram and whatsapp sites. The use of Autopsy as a forensic tool has proven to be able to acquire digital evidence well. In using the NIST 800-86 method in this research, it is proven that this method can be used properly in the acquisition of digital evidence. It is recommended to delete browser data and cache, or use the Auto-delete cookies and data feature, to prevent data leakage such as cookies, which contain usernames, emails, passwords, and other important data that may be misused.

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