



IT314

Software Engineering
Non-Functional Testing

Topic: Fluentify – Language Learning App

Group-ID: 3

Performance and Scalability:

Overview:

Load testing in JMeter focuses on evaluating how a system behaves under varying user loads and traffic conditions. To effectively conduct load or performance testing, a JMeter Test Plan typically includes Listener components. Listeners

capture, record, and visualize the results of each request executed during the test. They present response data in multiple formats—such as trees, tables, graphs, and log files—making it easier to analyse system behaviour. These results can also be exported for detailed post-test analysis and reporting.

Different types of JMeter Listeners: -

- Summary Report
- Aggregate Report
- Aggregate Graph
- View Results Tree
- View Results in Table

Parameters in Summary Report: -

The Summary Report in JMeter offers key metrics and insights into the performance test.

1. Samples

- Shows number of virtual users executed the specified task.

2. Average Response time (Avg)

- Displays the average response time taken for all requests under a particular label (in milliseconds).

3. Minimum Response time (Min)

- Shows shortest response time taken by any sample for some given label

4. Maximum Response time (Max)

- Displays the longest response time taken by any sample for some given label

5. Standard Deviation (Std. Dev)

- Measures the inconsistency in response time
- Lower standard deviation means more stable performance.

6. Error Percentage (Error %)

- Represents the proportion of requests that failed during test (shown in percentage)

7. Throughput

- It indicates the number of server requests handled per second
- Higher throughput indicates better performance

8. Data transfer rate

- It is the throughput expressed in terms of data size
- It is the volume of data downloaded from the server per second.

Web Pages: -

- Login Page
- Dash Board
- Module Page and respective contents
- Contest Page and respective contents
- Progress
- Profile
- Admin Dash Board

Test results:

1. Login Page:

100 users

[illegible]

1000 users

[illegible]

2500 users

[illegible]

4000 users

[illegible]

Label	Samples (no.)	Average (millisec)	Error (%)	Throughput (Kb/sec)
Login	100	2158	0.00	17.4
	1000	9700	0.00	57.2
	2500	15781	6.00	80.6
	4000	19267	2.73	87.1

2. Dash Board:

100 users

[illegible]

500 users

[illegible]

1000 users

[illegible]

Label	Samples (No.)	Average (millisec)	Error (%)	Throughput (Kb/sec)
Dash Board	100	1287	0.00	23.1
	500	2086	0.00	101.6
	1000	55018	30.00	14.4

3. Profile:

100 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Profile	100	434	178	768	147.06	0.00%	44.5/sec	43.24	5.79	994.1
TOTAL	100	434	178	768	147.06	0.00%	44.5/sec	43.24	5.79	994.1

500 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Profile	500	4806	519	6680	1595.27	0.00%	58.2/sec	56.47	7.55	994.1
TOTAL	500	4806	519	6680	1595.27	0.00%	58.2/sec	56.47	7.55	994.1

1000 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Profile	1000	17768	6406	28531	4871.62	0.00%	32.9/sec	31.89	4.27	994.1
TOTAL	1000	17768	6406	28531	4871.62	0.00%	32.9/sec	31.89	4.27	994.1

Label	Samples (No.)	Average (millisec)	Error (%)	Throughput (Kb/sec)
Profile	100	434	0.00	44.5
	500	4806	0.00	58.2
	1000	17768	0.00	32.9

4. Modules:

100 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Modules	100	412	182	1365	248.77	0.00%	43.3/sec	42.11	6.00	996.0
Hindi Module	100	117	49	548	79.24	0.00%	47.6/sec	46.25	6.87	996.0
Course Content	100	133	52	545	93.72	0.00%	46.3/sec	45.05	6.42	996.0
TOTAL	300	221	49	1365	209.74	0.00%	120.5/sec	117.23	16.95	996.0

500 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Modules	500	4996	685	9200	2803.95	0.00%	44.7/sec	43.45	6.20	996.0
Hindi Module	500	4893	415	6270	1478.24	0.00%	31.4/sec	30.55	4.54	996.0
Course Content	500	4743	1210	6263	1020.16	0.00%	25.7/sec	25.04	3.57	996.0
TOTAL	1500	4877	415	9200	1925.31	0.00%	72.8/sec	70.83	10.24	996.0

1000 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Modules	1000	11016	265	18785	6396.26	0.00%	48.1/sec	46.83	6.68	996.0
Hindi Module	1000	9804	287	13491	3198.65	0.00%	32.4/sec	31.50	4.68	996.0
Course Content	1000	7372	725	13498	3026.23	0.00%	28.5/sec	27.68	3.95	996.0
TOTAL	3000	9397	265	18785	4732.52	0.00%	84.0/sec	81.72	11.81	996.0

Label	Samples (No.)	Average (millisec)	Error (%)	Throughput (Kb/sec)
Modules	100	221	0.00	120.5
	500	4877	0.00	72.8
	1000	9937	0.00	84.0

5. Contests:

100 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Contests	100	460	203	759	187.80	0.00%	37.0/sec	35.96	4.84	996.0
Hindi Contest	100	169	47	356	83.56	0.00%	39.5/sec	38.41	5.28	996.0
TOTAL	200	315	47	759	205.39	0.00%	70.6/sec	68.67	9.34	996.0

500 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Contests	500	2929	575	10186	1818.62	0.00%	48.9/sec	47.56	6.40	996.0
Hindi Contest	500	1363	44	7592	1021.09	0.00%	51.3/sec	49.94	6.87	996.0
TOTAL	1000	2146	44	10186	1669.74	0.00%	96.7/sec	94.04	12.79	996.0

1000 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Contests	1000	6955	1067	23406	3685.99	0.40%	41.5/sec	40.78	5.41	1006.5
Hindi Contest	1000	1209	46	10458	1152.47	0.00%	43.3/sec	42.09	5.79	996.0
TOTAL	2000	4082	46	23406	3963.83	0.20%	82.7/sec	80.87	10.92	1001.3

Label	Samples (No.)	Average (millisec)	Error (%)	Throughput (Kb/sec)
Contests	100	315	0.00	70.6
	500	2146	0.00	96.7
	1000	4082	0.20	82.7

6. Progress

100 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Progress	100	226	95	1280	190.37	0.00%	29.3/sec	28.50	3.83	996.0
TOTAL	100	226	95	1280	190.37	0.00%	29.3/sec	28.50	3.83	996.0

500 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Progress	500	1010	317	2312	426.42	0.00%	148.1/sec	144.05	19.38	996.0
TOTAL	500	1010	317	2312	426.42	0.00%	148.1/sec	144.05	19.38	996.0

1000 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Progress	1000	396	238	668	86.13	0.00%	284.9/sec	277.11	37.28	996.0
TOTAL	1000	396	238	668	86.13	0.00%	284.9/sec	277.11	37.28	996.0

Label	Samples (No.)	Average (millisec)	Error (%)	Throughput (Kb/sec)
Progress	100	226	0.00	29.3
	500	1010	0.00	148.1
	1000	396	0.00	284.9

7. Admin Dash Board

100 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Admin Dashboa...	100	316	153	892	185.65	0.00%	32.3/sec	31.41	4.45	996.0
TOTAL	100	316	153	892	185.65	0.00%	32.3/sec	31.41	4.45	996.0

500 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Admin Dashboa...	500	236	147	465	50.69	0.00%	154.4/sec	150.19	21.26	996.0
TOTAL	500	236	147	465	50.69	0.00%	154.4/sec	150.19	21.26	996.0

1000 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Admin Dashboa...	1000	570	337	816	93.68	0.00%	297.4/sec	289.31	40.96	996.0
TOTAL	1000	570	337	816	93.68	0.00%	297.4/sec	289.31	40.96	996.0

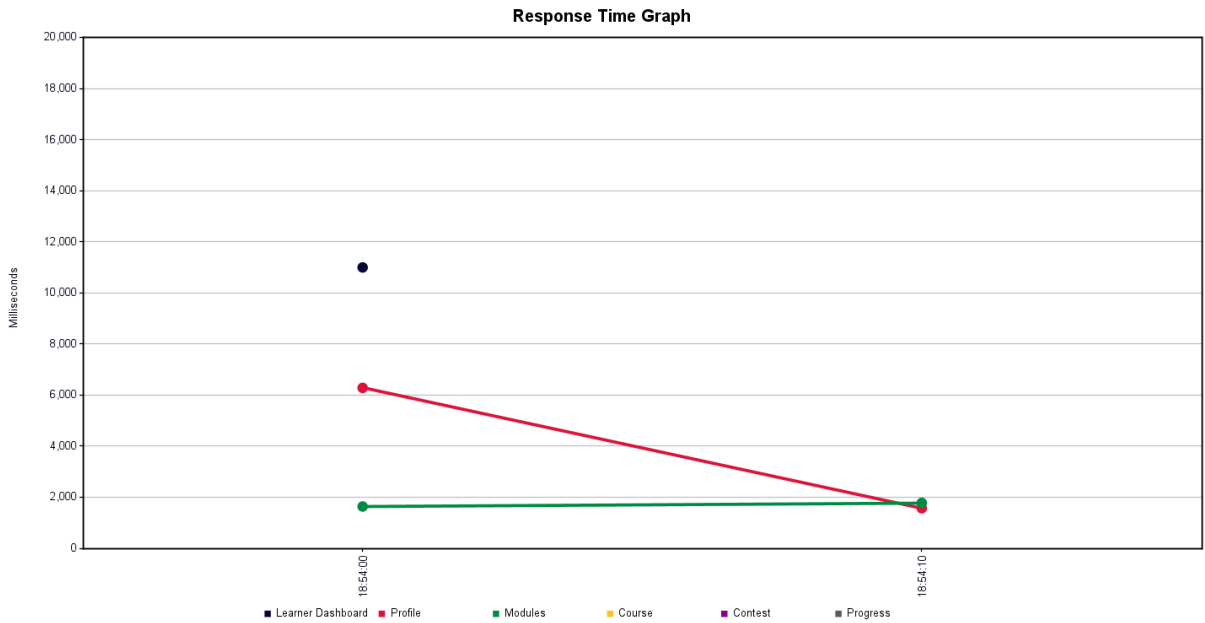
Label	Samples (No.)	Average (millisec)	Error (%)	Throughput (Kb/sec)
Admin Dash Board	100	316	0.00	32.3
	500	236	0.00	154.4
	1000	570	0.00	297.4

- All the above results mentioned displays the breakdown point of individual pages beyond which the error increases significantly crossing the average range of 10% making the conditions vulnerable.

8. Performance testing: - Response time graphs

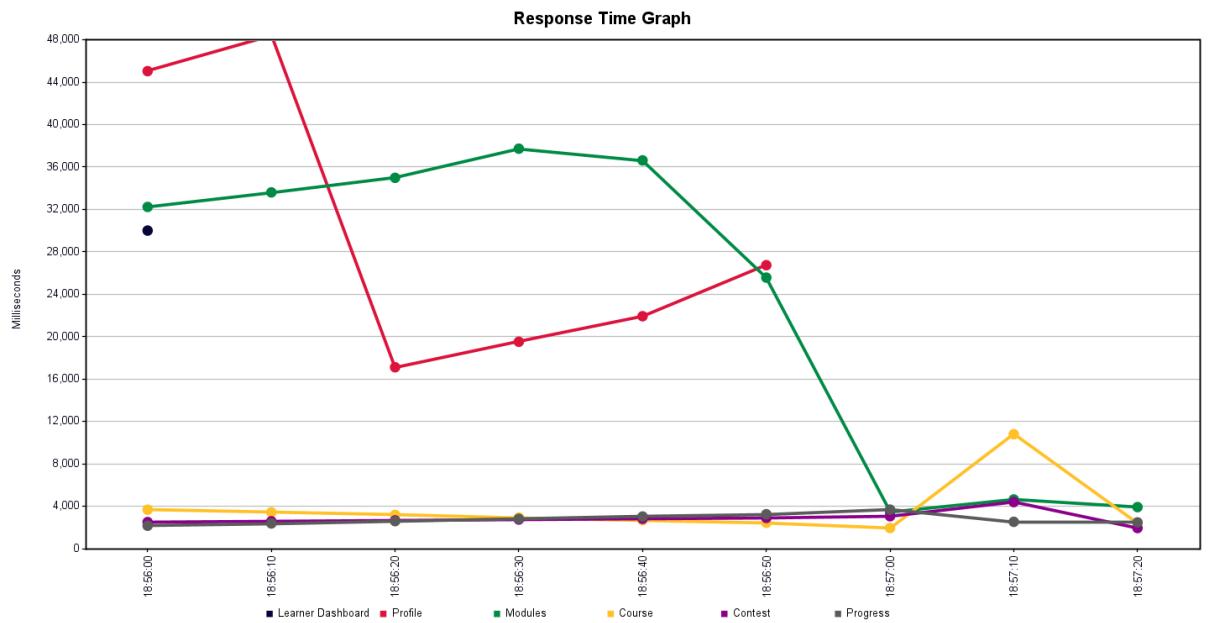
100 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Learner Dashbo...	100	10997	10179	12030	529.74	0.00%	7.6/sec	7.38	1.00	996.0
Profile	100	1566	1149	1939	284.95	0.00%	32.5/sec	31.60	4.22	996.0
Modules	100	1660	1332	2218	258.57	0.00%	31.6/sec	30.76	4.39	996.0
Course	100	961	471	1454	279.18	0.00%	50.8/sec	49.45	7.35	996.0
Contest	100	367	255	509	58.41	0.00%	116.3/sec	113.10	15.22	996.0
Progress	100	307	217	420	60.69	0.00%	154.8/sec	150.57	20.26	996.0
TOTAL	600	2643	217	12030	3783.71	0.00%	34.4/sec	33.49	4.63	996.0



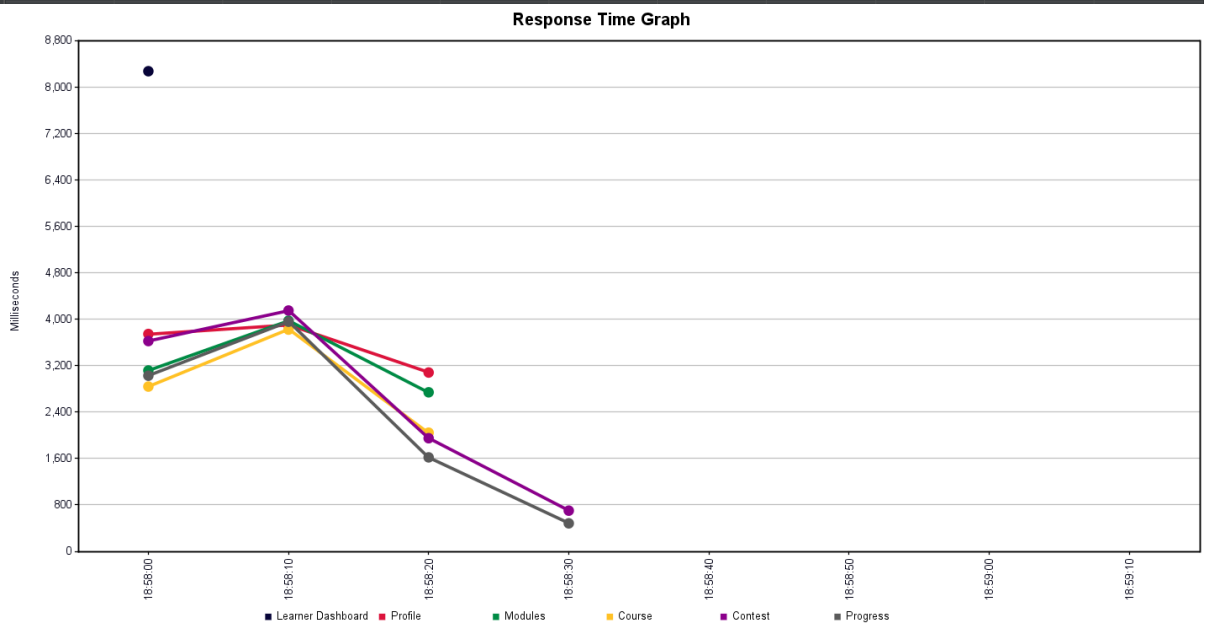
500 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Learner Dashbo...	500	30005	14057	49651	16227.88	100.00%	9.5/sec	29.81	0.00	3212.7
Profile	500	21588	6804	49175	7494.23	81.00%	7.0/sec	19.26	0.17	2800.2
Modules	500	22787	87	50582	16834.39	50.20%	9.4/sec	19.05	0.65	2082.8
Course	500	6919	63	20744	5904.45	0.00%	18.0/sec	17.56	2.61	996.0
Contest	500	1720	87	22378	2271.38	0.00%	18.0/sec	17.48	2.35	996.0
Progress	500	1012	86	22050	1875.45	0.00%	18.8/sec	18.33	2.47	996.0
TOTAL	3000	14005	63	50582	15313.43	38.53%	34.1/sec	61.49	2.84	1847.3



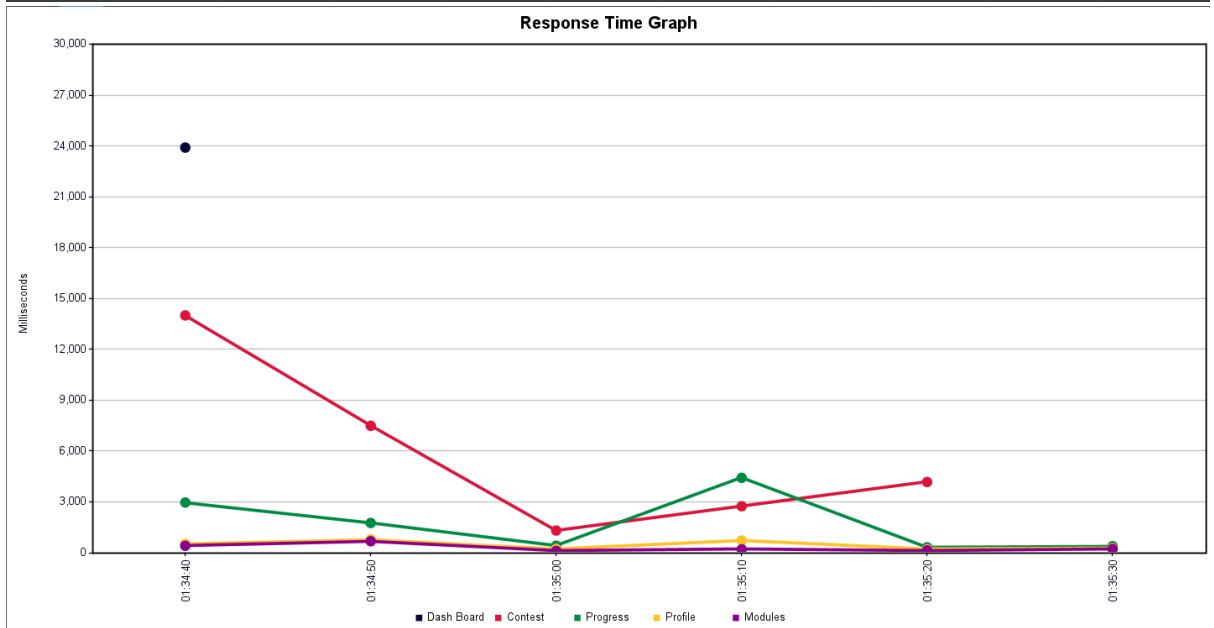
1000 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Learner Dashbo...	1000	8278	677	72469	8313.81	7.90%	13.3/sec	15.29	1.61	1179.4
Profile	1000	3646	471	10954	1505.57	5.60%	13.3/sec	14.56	1.63	1122.3
Modules	1000	3151	54	8990	1284.84	0.00%	13.4/sec	12.99	1.85	996.0
Course	1000	2661	49	4605	989.59	0.00%	13.8/sec	13.42	1.99	996.0
Contest	1000	2119	49	4651	799.47	0.00%	14.3/sec	13.95	1.88	996.0
Progress	1000	1598	42	4441	680.15	0.00%	15.2/sec	14.76	1.99	996.0
TOTAL	6000	3576	42	72469	4169.09	2.25%	78.6/sec	80.46	10.34	1047.6



2500 users

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
Dash Board	2500	23907	1226	42125	14489.36	28.56%	56.2/sec	84.88	5.30	1545.3
Contest	2500	4825	57	36332	6516.86	9.28%	42.6/sec	51.31	5.06	1233.5
Progress	2500	1666	40	28294	3799.50	0.60%	47.3/sec	46.70	6.15	1011.4
Profile	2500	471	38	28306	1500.40	0.00%	49.9/sec	48.56	6.48	996.0
Modules	2500	304	39	894	238.40	0.00%	51.0/sec	49.64	7.08	996.0
TOTAL	12500	6235	38	42125	11599.27	7.69%	205.7/sec	232.25	25.15	1156.4



Samples (no.of)	Ramp-up period (sec)	Loop count	Average throughput (Kb/sec)	Error (%)
100	2	1	34.4	0.00
500	2	1	34.1	38.53
1000	2	1	78.6	2.25
2500	2	1	205.7	7.69

- At 2500 individual user threads, the system's error rate rose significantly to 7.69 and at 3000 user threads it went on beyond range increasing rapidly indicating system's stress limit is at 2500 users on an average. This shows the system begins to struggle under increasing load beyond this point, compromising its performance.

Conclusion:

The non-functional testing carried out using Apache JMeter effectively evaluated the performance, stability, and scalability of the Fluentify web application. Load and stress tests were executed across multiple modules, including Login, Dashboard, Profile, Modules, Contests, Progress, and Admin Dashboard.

Security and Privacy:

Overview:

ZAP scanning helps evaluate the security posture of a web application by analysing requests, responses, and system behaviour across different scanning modes. In all three scans performed—API Scan, DevTools Scan, and Full Scan—**0 alerts** were reported. This indicates that ZAP did not identify any exploitable vulnerabilities within the covered categories. The scan results, which can be viewed through ZAP's reporting and alert management features, summarize the security assessment and can be exported for further review or documentation.

Different tools used:

- OWASP ZAP (Active scan, API scan, DevTools scan)
- Browse DevTools
- Automated vulnerability plugins included in ZAP

Test types conducted:

- API Security test
- DevTools Automated scan
- Active scan

Different scan categories covered:

Below is a consolidated list of security checks performed across all scans:

- Path Traversal
- Remote File Inclusion
- External Redirect
- Server Side Include
- SQL Injection (MySQL, PostgreSQL, Oracle, SQLite)
- Cross-Site Scripting (Reflected, Persistent, DOM)
- Server-Side Code Injection
- Remote OS Command Injection (Regular & Time Based)
- XPath Injection
- XML External Entity Attack (XXE)
- Cloud Metadata Exposure
- Directory Browsing
- Buffer Overflow
- Format String Error
- CRLF Injection
- Parameter Tampering
- Spring Actuator Information Leak
- Log4Shell
- XSLT Injection
- SOAP XML Injection
- Hidden File Finder

- GET for POST
- User Agent Fuzzer
- ELMAH / Trace.axd / .htaccess / .env leak tests

Test Results:

1. API Security Test

https://fluent.rho.vercel.app Scan Progress						
Progress		Response Chart				
Host:		https://fluentify-rho.vercel.app				
	Strength	Progress	Elapsed	Reqs	Alerts	Status
Analyser			00:00.294	4		
Plugin						
Remote File Inclusion	Medium		00:00.148	0	0	✓
External Redirect	Medium		00:00.149	0	0	✓
Server Side Include	Medium		00:00.144	0	0	✓
SQL Injection	Medium		00:00.143	0	0	✓
Server Side Code Injection	Medium		00:00.154	0	0	✓
Remote OS Command Injection	Medium		00:00.156	0	0	✓
XPath Injection	Medium		00:00.147	0	0	✓
XML External Entity Attack	Medium		00:00.159	0	0	✓
Cloud Metadata Potentially Exposed	Medium		00:00.714	9	0	✓
Server Side Template Injection	Medium		00:00.648	0	0	✓
Server Side Template Injection (Blind)	Medium		00:00.150	0	0	✓
Remote OS Command Injection (Time Based)	Medium		00:00.152	0	0	✓
Directory Browsing	Medium		00:00.746	8	0	✓
Buffer Overflow	Medium		00:00.153	0	0	✓
Format String Error	Medium		00:00.146	0	0	✓
CRLF Injection	Medium		00:00.138	0	0	✓
Parameter Tampering	Medium		00:00.149	0	0	✓
Spring Actuator Information Leak	Medium		00:00.241	2	0	✓
XSLT Injection	Medium		00:00.176	0	0	✓
Script Active Scan Rules	Medium		00:00.085	0	0	✗
SOAP Action Spoofing	Medium		00:00.310	0	0	✓
SOAP XML Injection	Medium		00:00.177	0	0	✓
Totals			00:04.665	64	0	

- The above result shows that all the security plugins have been successfully completed. No security alerts have been reported. All the API end points responded safely to the injection tests.

2. DevTools Automated Scan

https://fluent.rho.vercel.app Scan Progress						
Progress		Response Chart				
Host:		https://fluentify-rho.vercel.app				
	Strength	Progress	Elapsed	Reqs	Alerts	Status
Analyser			00:00.299	4		
Plugin						
Path Traversal	Medium		00:00.156	0	0	✓
Remote File Inclusion	Medium		00:00.171	0	0	✓
External Redirect	Medium		00:00.152	0	0	✓
Server Side Include	Medium		00:00.160	0	0	✓
Cross Site Scripting (Reflected)	Medium		00:00.154	0	0	✓
Cross Site Scripting (Persistent) - Prime	Medium		00:00.161	0	0	✓
Cross Site Scripting (Persistent) - Spider	Medium		00:00.728	8	0	✓
Cross Site Scripting (Persistent)	Medium		00:00.141	0	0	✓
SQL Injection	Medium		00:00.150	0	0	✓
SQL Injection - MySQL (Time Based)	Medium		00:00.155	0	0	✓
SQL Injection - Hypersonic SQL (Time Based)	Medium		00:00.143	0	0	✓
SQL Injection - Oracle (Time Based)	Medium		00:00.146	0	0	✓
SQL Injection - PostgreSQL (Time Based)	Medium		00:00.138	0	0	✓
Cross Site Scripting (DOM Based)	Medium		00:00.130	0	0	✗
SQL Injection - MsSQL (Time Based)	Medium		00:00.144	0	0	✓
Server Side Code Injection	Medium		00:00.137	0	0	✓
Remote OS Command Injection	Medium		00:00.140	0	0	✓
XPath Injection	Medium		00:00.137	0	0	✓
XML External Entity Attack	Medium		00:00.132	0	0	✓
Server Side Template Injection	Medium		00:00.131	0	0	✓
Server Side Template Injection (Blind)	Medium		00:00.139	0	0	✓
Remote OS Command Injection (Time Based)	Medium		00:00.133	0	0	✓
CRLF Injection	Medium		00:00.138	0	0	✓
Parameter Tampering	Medium		00:00.145	0	0	✓
XSLT Injection	Medium		00:00.137	0	0	✓
Script Active Scan Rules	Medium		00:00.064	0	0	✗
SOAP Action Spoofing	Medium		00:00.139	0	0	✓
SOAP XML Injection	Medium		00:00.133	0	0	✓
Totals			00:04.843	67	0	

- The above results indicates no vulnerabilities have been reported. DevTools automation covered client-side vulnerabilities such as XSS, redirects, and metadata leaks.

3. Active Scan

Progress Response Chart						
Host:		https://fluentify-rho.vercel.app				
	Strength	Progress	Elapsed	Reqs	Alerts	Status
Analyser			00:00.318	4		
Plugin						
Path Traversal	Medium		00:00.156	0	0	✓
Remote File Inclusion	Medium		00:00.156	0	0	✓
Heartbleed OpenSSL Vulnerability	Medium		00:00.687	4	0	✓
Source Code Disclosure - /WEB-INF Folder	Medium		00:00.803	6	0	✓
Source Code Disclosure - CVE-2012-1823	Medium		00:00.850	1	0	✓
Remote Code Execution - CVE-2012-1823	Medium		00:00.572	16	0	✓
External Redirect	Medium		00:00.282	0	0	✓
Server Side Include	Medium		00:00.272	0	0	✓
Cross Site Scripting (Reflected)	Medium		00:00.152	0	0	✓
Cross Site Scripting (Persistent) - Prime	Medium		00:00.144	0	0	✓
Cross Site Scripting (Persistent) - Spider	Medium		00:00.827	8	0	✓
Cross Site Scripting (Persistent)	Medium		00:00.141	0	0	✓
SQL Injection	Medium		00:00.140	0	0	✓
SQL Injection - MySQL (Time Based)	Medium		00:00.174	0	0	✓
SQL Injection - Hypersonic SQL (Time Based)	Medium		00:00.166	0	0	✓
SQL Injection - Oracle (Time Based)	Medium		00:00.141	0	0	✓
SQL Injection - PostgreSQL (Time Based)	Medium		00:00.141	0	0	✓
SQL Injection - SQLite (Time Based)	Medium		00:00.143	0	0	✓
Cross Site Scripting (DOM Based)	Medium		00:00.224	0	0	✗
SQL Injection - MsSQL (Time Based)	Medium		00:00.137	0	0	✓
Log4Shell	Medium		00:00.070	0	0	✗
Spring4Shell	Medium		00:00.715	17	0	✓
Server Side Code Injection	Medium		00:00.320	0	0	✓
Remote OS Command Injection	Medium		00:00.154	0	0	✓
XPath Injection	Medium		00:00.158	0	0	✓
XML External Entity Attack	Medium		00:00.151	0	0	✓
Generic Padding Oracle	Medium		00:00.151	0	0	✓
Cloud Metadata Potentially Exposed	Medium		00:01.309	9	0	✓
Server Side Template Injection	Medium		00:01.236	0	0	✓
Server Side Template Injection (Blind)	Medium		00:00.324	0	0	✓
Remote OS Command Injection (Time Based)	Medium		00:00.151	0	0	✓
Directory Browsing	Medium		00:00.807	8	0	✓
Buffer Overflow	Medium		00:00.146	0	0	✓
Format String Error	Medium		00:00.146	0	0	✓
CRLF Injection	Medium		00:00.147	0	0	✓
Parameter Tampering	Medium		00:00.148	0	0	✓
ELMAH Information Leak	Medium		00:00.134	1	0	✓
Trace.axd Information Leak	Medium		00:00.209	3	0	✓
.htaccess Information Leak	Medium		00:00.223	2	0	✓
.env Information Leak	Medium		00:00.217	2	0	✓
Spring Actuator Information Leak	Medium		00:00.206	2	0	✓
Hidden File Finder	Medium		00:04.060	52	0	✓
XSLT Injection	Medium		00:03.907	0	0	✓
GET for POST	Medium		00:00.154	0	0	✓
User Agent Fuzzer	Medium		00:05.453	96	0	✓
Script Active Scan Rules	Medium		00:00.072	0	0	✗
SOAP Action Spoofing	Medium		00:00.143	0	0	✓
SOAP XML Injection	Medium		00:00.145	0	0	✓
Totals			00:20.758	319	0	

- Full scan is executed in 319 requests. The web application has passed out all the vulnerability checks without detecting issues. All the plugins have been marked as successful.

Conclusion:

After combining the test results with manual penetration testing, secure coding reviews and

continuous monitoring the security posture of the website based on all these reports appears ****strong**** with ****no vulnerabilities detected**** ensuring users with their data privacy.