

Experimental Report

# Development and Deployment of Java Servlets Using VS Code and Apache Tomcat



**Student Name:** Mohammad Abdullah

**Student ID:** 202322240356

**Course:** Java Web

**Date:** 13 November 2025

**Instructor:** D.cora

Department of Computer Science  
China West Normal University  
Academic Year: 2025

---

# Contents

---

<b>1</b>	<b>Objective</b>	<b>2</b>
<b>2</b>	<b>Environment Setup &amp; Tools</b>	<b>3</b>
<b>3</b>	<b>Project Design and Implementation</b>	<b>4</b>
3.1	Project Structure . . . . .	4
3.2	pom.xml Configuration . . . . .	4
3.3	ChineseServlet Implementation . . . . .	6
3.4	ShowTimesServlet Implementation . . . . .	8
3.5	Front-End (index.html) . . . . .	13
<b>4</b>	<b>Build and Deployment Procedure</b>	<b>14</b>
4.1	Build Using Maven . . . . .	14
4.2	Deploy to Tomcat . . . . .	15
<b>5</b>	<b>Testing and Results</b>	<b>16</b>
<b>6</b>	<b>Common Issues and Resolutions</b>	<b>17</b>
<b>7</b>	<b>Conclusion</b>	<b>18</b>

# CHAPTER 1

---

## Objective

---

The primary objective of this experiment is to design, implement, and deploy two Java Servlets using Visual Studio Code, Apache Maven, and Apache Tomcat 11. The experiment demonstrates:

- UTF-8 based web content generation using Servlets.
- Visit-count persistence using ServletContext.
- Maven-based project management and Tomcat deployment.

# CHAPTER 2

## Environment Setup & Tools

Table 2.1: Software and Tools Used

Component	Version / Description
Operating System	Windows 11
IDE	Visual Studio Code 1.94+
Extensions	Extension Pack for Java, Community Server Connectors
JDK	Eclipse Adoptium JDK 17.0.15
Build Tool	Apache Maven 3.9.11
Application Server	Apache Tomcat 11.0.0-M6

Figure: Example of configured Tomcat Server view in VS Code.

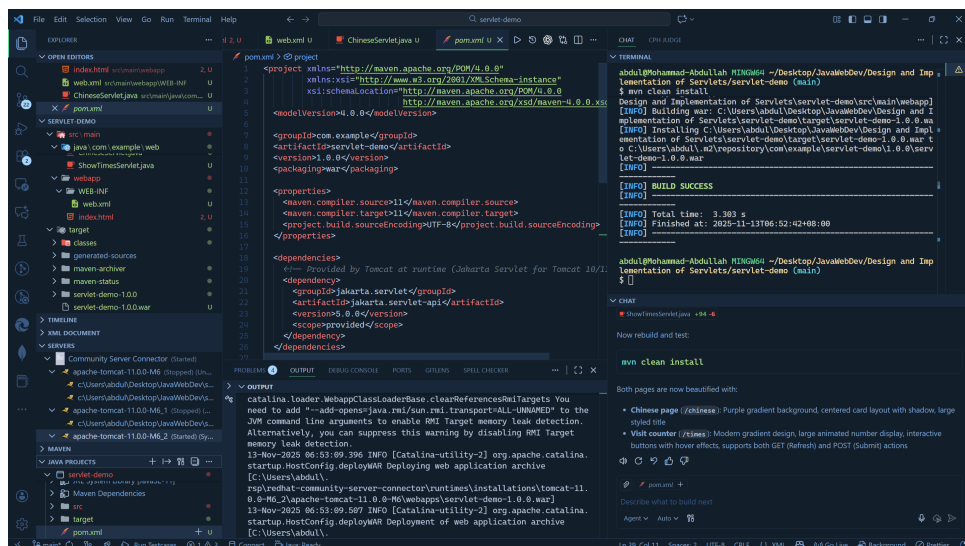


Figure 2.1: VS Code with Tomcat integration.

# CHAPTER 3

---

## Project Design and Implementation

---

### 3.1 Project Structure

The Maven Web Application was created using the `maven-archetype-webapp` template.

```
servlet-demo/  
  src/  
    main/  
      java/  
        com/example/web/  
          ChineseServlet.java  
          ShowTimesServlet.java  
      webapp/  
        WEB-INF/  
          web.xml  
          index.html  
  pom.xml  
  target/servlet-demo.war
```

### 3.2 pom.xml Configuration

Listing 3.1: pom.xml configuration for Jakarta Servlet API 5.0.0

```
1 <project xmlns="http://maven.apache.org/POM/4.0.0"  
2     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"  
3     xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
```



Figure 3.1: Project structure in VS Code.

```

4                                     http://maven.apache.org/xsd/maven-4.0.0.
                                     xsd">
5 <modelVersion>4.0.0</modelVersion>
6
7 <groupId>com.example</groupId>
8 <artifactId>servlet-demo</artifactId>
9 <version>1.0.0</version>
10 <packaging>war</packaging>
11
12 <properties>
13     <maven.compiler.source>11</maven.compiler.source>
14     <maven.compiler.target>11</maven.compiler.target>
15     <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
16 </properties>
17
18 <dependencies>

```

```

19      <!-- Provided by Tomcat at runtime (Jakarta Servlet for Tomcat
20           10/11+) -->
21      <dependency>
22          <groupId>jakarta.servlet</groupId>
23          <artifactId>jakarta.servlet-api</artifactId>
24          <version>5.0.0</version>
25          <scope>provided</scope>
26      </dependency>
27  </dependencies>
28
29  <build>
30      <plugins>
31          <plugin>
32              <artifactId>maven-war-plugin</artifactId>
33              <version>3.4.0</version>
34              <configuration>
35                  <failOnMissingWebXml>>false</failOnMissingWebXml>
36              </configuration>
37          </plugin>
38      </plugins>
39  </build>
</project>

```

### 3.3 ChineseServlet Implementation

Listing 3.2: ChineseServlet.java – UTF-8 text rendering in Servlet

```

1  package com.example.web;
2
3  import jakarta.servlet.ServletException;
4  import jakarta.servlet.annotation.WebServlet;
5  import jakarta.servlet.http.HttpServlet;
6  import jakarta.servlet.http.HttpServletRequest;
7  import jakarta.servlet.http.HttpServletResponse;
8  import jakarta.servlet.ServletOutputStream;
9  import java.io.IOException;
10 import java.nio.charset.StandardCharsets;
11
12 @WebServlet(name = "ChineseServlet", urlPatterns = "/chinese")
13 public class ChineseServlet extends HttpServlet {
14
15     @Override
16     protected void doGet(HttpServletRequest request,
17                          HttpServletResponse response)
18         throws ServletException, IOException {

```

```

18
19 // Set browser encoding to UTF-8
20 response.setContentType("text/html; charset=UTF-8");
21 response.setCharacterEncoding("UTF-8");
22
23 String text = "  J  a  v  a  W  e  b  ";
24
25 // Use output stream and write UTF-8 bytes
26 try (ServletOutputStream out = response.getOutputStream()) {
27     String html = "<!DOCTYPE html>\n" +
28         "<html lang='zh-CN'>\n" +
29         "<head>\n" +
30         "    <meta charset='UTF-8'>\n" +
31         "    <meta name='viewport' content='width=device-
32         width, initial-scale=1.0'>\n" +
33         "    <title>          - J a v a W e b  </
34         title>\n" +
35         "    <style>\n" +
36         "        * { margin: 0; padding: 0; box-sizing:
37         border-box; }\n" +
38         "        body {\n" +
39         "            font-family: 'Microsoft YaHei', '
40         ', Arial, sans-serif;\n" +
41         "            background: linear-gradient(135deg,
42         #667eea 0%, #764ba2 100%);\n" +
43         "            min-height: 100vh;\n" +
44         "            display: flex;\n" +
45         "            justify-content: center;\n" +
46         "            align-items: center;\n" +
47         "            padding: 20px;\n" +
48         "        }\n" +
49         "        .container {\n" +
50         "            background: white;\n" +
51         "            border-radius: 12px;\n" +
52         "            box-shadow: 0 10px 40px rgba(0, 0, 0,
53         0.2);\n" +
54         "            padding: 60px 40px;\n" +
55         "            text-align: center;\n" +
56         "            max-width: 500px;\n" +
57         "        }\n" +
58         "        h1 {\n" +
59         "            color: #333;\n" +
60         "            font-size: 2.5em;\n" +
61         "            margin-bottom: 20px;\n" +
62         "            text-shadow: 2px 2px 4px rgba(0, 0, 0,
63         0.1);\n" +

```



```

57         "}\n" +
58         ".badge {\n" +
59         "         display: inline-block;\n" +
60         "         background: linear-gradient(135deg,
        #667eea 0%, #764ba2 100%);\n" +
61         "         color: white;\n" +
62         "         padding: 10px 20px;\n" +
63         "         border-radius: 50px;\n" +
64         "         font-size: 0.9em;\n" +
65         "         margin-top: 15px;\n" +
66         "     }\n" +
67         "</style>\n" +
68         "</head>\n" +
69         "<body>\n" +
70         "     <div class='container'>\n" +
71         "         <h1>" + text + "</h1>\n" +
72         "         <div class='badge'>                                </div>
        >\n" +
73         "     </div>\n" +
74         "</body>\n" +
75         "</html>";
76         out.write(html.getBytes(StandardCharsets.UTF_8));
77     }
78 }
79 }

```

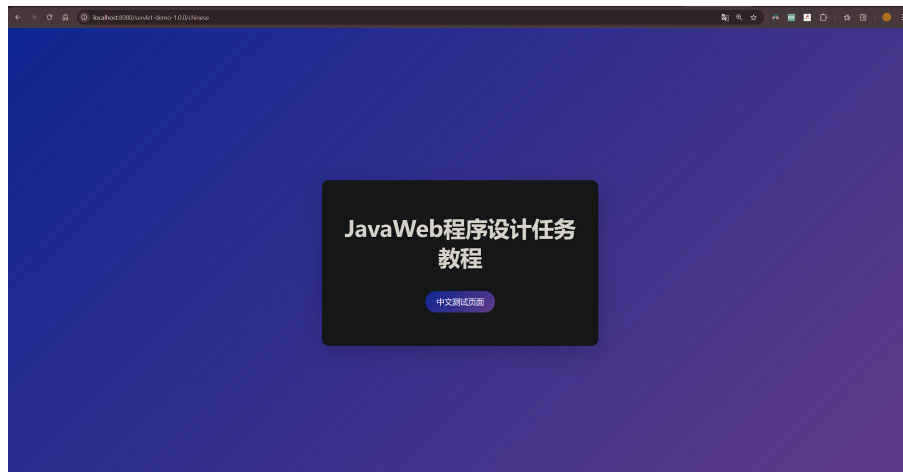


Figure 3.2: Browser output of ChineseServlet displaying UTF-8 text.

### 3.4 ShowTimesServlet Implementation

Listing 3.3: ShowTimesServlet.java – Counting website visits using ServletContext

```

1 package com.example.web;
2
3 import jakarta.servlet.ServletContext;
4 import jakarta.servlet.ServletException;
5 import jakarta.servlet.annotation.WebServlet;
6 import jakarta.servlet.http.HttpServlet;
7 import jakarta.servlet.http.HttpServletRequest;
8 import jakarta.servlet.http.HttpServletResponse;
9 import java.io.IOException;
10 import java.io.PrintWriter;
11 import java.util.concurrent.atomic.AtomicLong;
12
13 @WebServlet(name = "ShowTimesServlet", urlPatterns = "/times")
14 public class ShowTimesServlet extends HttpServlet {
15
16     private static final String ATTR = "visitCount";
17
18     @Override
19     public void init() throws ServletException {
20         // Initialize the counter once per webapp
21         ServletContext ctx = getServletContext();
22         synchronized (ctx) {
23             if (ctx.getAttribute(ATTR) == null) {
24                 ctx.setAttribute(ATTR, new AtomicLong(0));
25             }
26         }
27     }
28
29     @Override
30     protected void doPost(HttpServletRequest request,
31                             HttpServletResponse response)
32                             throws ServletException, IOException {
33         // Delegate to doGet
34         doGet(request, response);
35     }
36
37     @Override
38     protected void doGet(HttpServletRequest request,
39                             HttpServletResponse response)
40                             throws IOException {
41         response.setContentType("text/html; charset=UTF-8");
42         response.setCharacterEncoding("UTF-8");
43
44         ServletContext ctx = getServletContext();
45         AtomicLong counter;
46         synchronized (ctx) {

```

```

45     counter = (AtomicLong) ctx.getAttribute(ATTR);
46     if (counter == null) { // safety in case the context was
47         reloaded
48         counter = new AtomicLong(0);
49         ctx.setAttribute(ATTR, counter);
50     }
51 }
52
53 long visits = counter.incrementAndGet(); // increase by 1 each
54 request
55
56 try (PrintWriter out = response.getWriter()) {
57     String html = "<!DOCTYPE html>\n" +
58         "<html lang='en'>\n" +
59         "<head>\n" +
60         "    <meta charset='UTF-8'>\n" +
61         "    <meta name='viewport' content='width=device-
62         width, initial-scale=1.0'>\n" +
63         "    <title>Visit Counter</title>\n" +
64         "    <style>\n" +
65         "        * { margin: 0; padding: 0; box-sizing:
66         border-box; }\n" +
67         "        body {\n" +
68         "            font-family: 'Segoe UI', Tahoma,
69         Geneva, Verdana, sans-serif;\n" +
70         "            background: linear-gradient(135deg,
71         #667eea 0%, #764ba2 100%);\n" +
72         "            min-height: 100vh;\n" +
73         "            display: flex;\n" +
74         "            justify-content: center;\n" +
75         "            align-items: center;\n" +
76         "            padding: 20px;\n" +
77         "        }\n" +
78         "        .container {\n" +
79         "            background: white;\n" +
80         "            border-radius: 12px;\n" +
81         "            box-shadow: 0 10px 40px rgba(0, 0, 0,
82         0.2);\n" +
83         "            padding: 60px 40px;\n" +
84         "            text-align: center;\n" +
85         "            max-width: 500px;\n" +
86         "        }\n" +
87         "        h1 {\n" +
88         "            color: #333;\n" +
89         "            font-size: 2.5em;\n" +
90         "            margin-bottom: 10px;\n"

```

```

84         }\n" +
85         ".visit-count {\n" +
86         "         font-size: 3.5em;\n" +
87         "         background: linear-gradient(135deg,
#667eea 0%, #764ba2 100%);\n" +
88         "-webkit-background-clip: text;\n" +
89         "-webkit-text-fill-color: transparent;\n
n" +
90         "         background-clip: text;\n" +
91         "         font-weight: bold;\n" +
92         "         margin: 20px 0;\n" +
93         "}\n" +
94         p {\n" +
95         "         color: #666;\n" +
96         "         font-size: 1.1em;\n" +
97         "         margin-bottom: 30px;\n" +
98         "         line-height: 1.6;\n" +
99         "}\n" +
100        ".button-group {\n" +
101        "         display: flex;\n" +
102        "         gap: 15px;\n" +
103        "         justify-content: center;\n" +
104        "}\n" +
105        "        button {\n" +
106        "         padding: 12px 30px;\n" +
107        "         font-size: 1em;\n" +
108        "         border: none;\n" +
109        "         border-radius: 50px;\n" +
110        "         cursor: pointer;\n" +
111        "         font-weight: bold;\n" +
112        "         transition: all 0.3s ease;\n" +
113        "}\n" +
114        ".btn-refresh {\n" +
115        "         background: linear-gradient(135deg,
#667eea 0%, #764ba2 100%);\n" +
116        "         color: white;\n" +
117        "}\n" +
118        ".btn-refresh:hover {\n" +
119        "         transform: translateY(-2px);\n" +
120        "         box-shadow: 0 5px 15px rgba(102, 126,
234, 0.4);\n" +
121        "}\n" +
122        ".btn-post {\n" +
123        "         background: #f0f0f0;\n" +
124        "         color: #333;\n" +
125        "         border: 2px solid #667eea;\n" +

```

```

126         "}\n" +
127         ".btn-post:hover {\n" +
128         "         background: #667eea;\n" +
129         "         color: white;\n" +
130         "         transform: translateY(-2px);\n" +
131         "}\n" +
132         "</style>\n" +
133         "</head>\n" +
134         "<body>\n" +
135         "    <div class='container'>\n" +
136         "        <h1>        Website Visits</h1>\n" +
137         "        <div class='visit-count'>" + visits + "</div>\n" +
138         "        <p>Click the button below to increase the visit counter</p>\n" +
139         "        <div class='button-group'>\n" +
140         "            <button class='btn-refresh' onclick='location.reload()'>        Refresh</button>\n" +
141         "            <form method='POST' style='display: inline;'>\n" +
142         "                <button type='submit' class='btn-post'>        Submit (POST)</button>\n" +
143         "            </form>\n" +
144         "        </div>\n" +
145         "    </div>\n" +
146         "</body>\n" +
147         "</html>";
148         out.print(html);
149     }
150 }
151 }

```

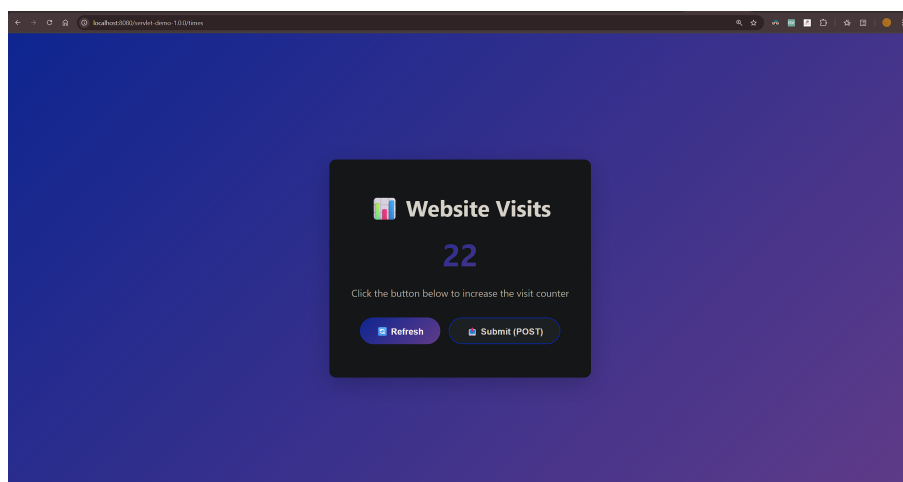


Figure 3.3: Browser output of ShowTimesServlet with visit counter.

## 3.5 Front-End (index.html)

Listing 3.4: index.html linking to both servlets

```
1 <!DOCTYPE html>
2 <html lang="en">
3   <head>
4     <meta charset="UTF-8" />
5     <title>Servlet Demo</title>
6   </head>
7   <body style="font-family: sans-serif">
8     <h2>Servlet Links</h2>
9     <ul>
10      <li><a href="chinese">ChineseServlet (/chinese)</a></li>
11      <li><a href="times">ShowTimesServlet (/times)</a></li>
12    </ul>
13  </body>
14 </html>
```

# CHAPTER 4

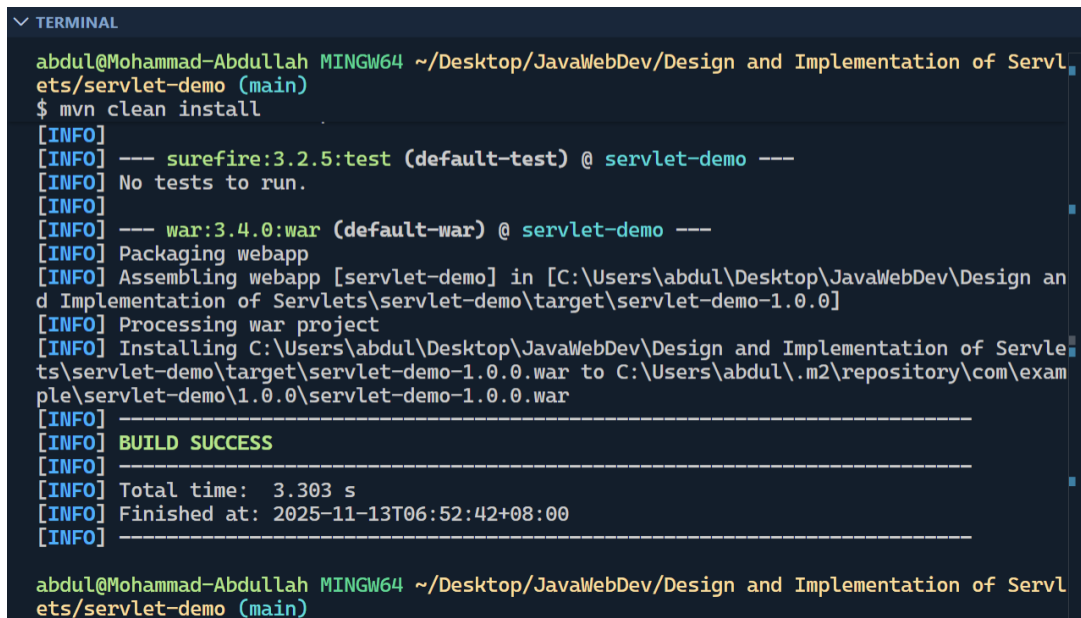
## Build and Deployment Procedure

### 4.1 Build Using Maven

Run the following in Command Prompt:

```
1 cd C:\Users\Mohammad\Documents\servlet-demo
2 mvn clean install
```

The WAR file is generated at: target/servlet-demo.war



```
▼ TERMINAL
abdul@Mohammad-Abdullah MINGW64 ~/Desktop/JavaWebDev/Design and Implementation of Servlets/servlet-demo (main)
$ mvn clean install
[INFO]
[INFO] --- surefire:3.2.5:test (default-test) @ servlet-demo ---
[INFO] No tests to run.
[INFO]
[INFO] --- war:3.4.0:war (default-war) @ servlet-demo ---
[INFO] Packaging webapp
[INFO] Assembling webapp [servlet-demo] in [C:\Users\abdul\Desktop\JavaWebDev\Design and Implementation of Servlets\servlet-demo\target\servlet-demo-1.0.0]
[INFO] Processing war project
[INFO] Installing C:\Users\abdul\Desktop\JavaWebDev\Design and Implementation of Servlets\servlet-demo\target\servlet-demo-1.0.0.war to C:\Users\abdul\.m2\repository\com\example\servlet-demo\1.0.0\servlet-demo-1.0.0.war
[INFO]
[INFO] BUILD SUCCESS
[INFO]
[INFO] Total time: 3.303 s
[INFO] Finished at: 2025-11-13T06:52:42+08:00
[INFO]
abdul@Mohammad-Abdullah MINGW64 ~/Desktop/JavaWebDev/Design and Implementation of Servlets/servlet-demo (main)
```

Figure 4.1: Maven build showing "BUILD SUCCESS" message.

## 4.2 Deploy to Tomcat

Copy the WAR file to: C:-tomcat-11.0.0-M6

Then start the server:

```
1 cd C:\apache-tomcat-11.0.0-M6\bin
2 startup.bat
```

### URLs:

- Base: `http://localhost:8080/servlet-demo/`
- ChineseServlet: `http://localhost:8080/servlet-demo/chinese`
- ShowTimesServlet: `http://localhost:8080/servlet-demo/times`



# CHAPTER 5

## Testing and Results

Table 5.1: Servlet Testing Summary

Servlet	Functionality	Result
ChineseServlet	UTF-8 Text Rendering	Displays "JavaWeb"
ShowTimesServlet	Visit Counter	Increments on each request
index.html	Navigation Page	Links to both servlets

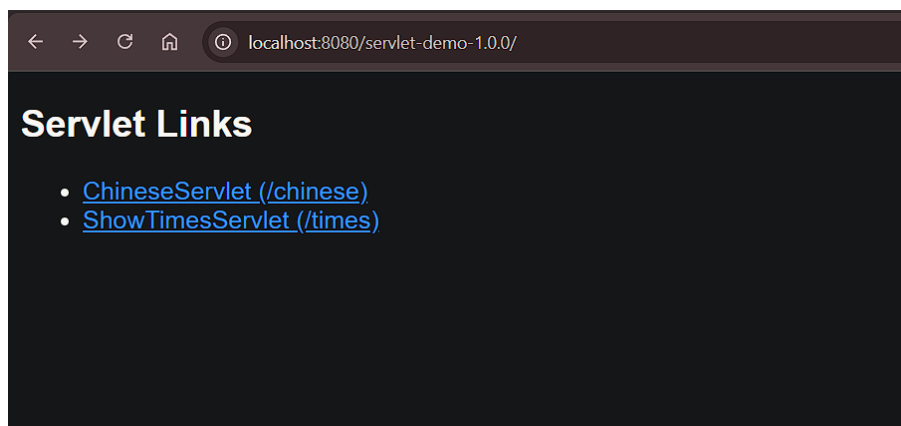


Figure 5.1: Index page providing servlet navigation.

# CHAPTER 6

---

## Common Issues and Resolutions

---

- **HTTP 404 Error:** Incorrect context path; fixed by using `/servlet-demo/`.
- **UTF-8 not displayed:** Added `setCharacterEncoding("UTF-8")` in response.
- **Counter reset after restart:** Stored counter in `ServletContext`.
- **Annotation not working:** Updated to Tomcat 11 (Jakarta EE 5 compatible).

# CHAPTER 7

---

## Conclusion

---

This experiment successfully demonstrated Java Servlet development using VS Code, Maven, and Tomcat 11. Both servlets performed as expected:

- **ChineseServlet** confirmed UTF-8 handling and dynamic HTML generation.
- **ShowTimesServlet** showed application-level state persistence using `ServletContext`.

The environment is now fully operational for further Jakarta EE web development.