Evaluating The Performance and Energy Efficiency of Web Browser

Hasanain Al-Sabonchi[1],Zong Ziling[2]
[1]Santa Monica College,[2]Texas State University

Background

Web browsers are the heart of search engines and without them we cannot search the internet. Web browsers are very popular and have many releases. Firefox updates their releases frequently and with each release software developers are less concerned about software energy efficiency. It is vital to study the energy efficiency of web browsers. Improvements in these releases can save energy.

Motivation

- ✓ Increase awareness about software energy consumption.
- ✓ Motivate software developers to write more energy efficient software.
- ✓ Increase battery/ hours of usage for mobile devices and laptops.

Methods

- ✓ The script was written using python..
- ✓ Selenium was used as a tool for the test automation.
- ✓ The web Driver was used to automate and control browser.
- ✓ The load time was measured using system time() methods for four different test run.
- ✓ The CPU power was the measured on Marcher server as a parameter for the energy.

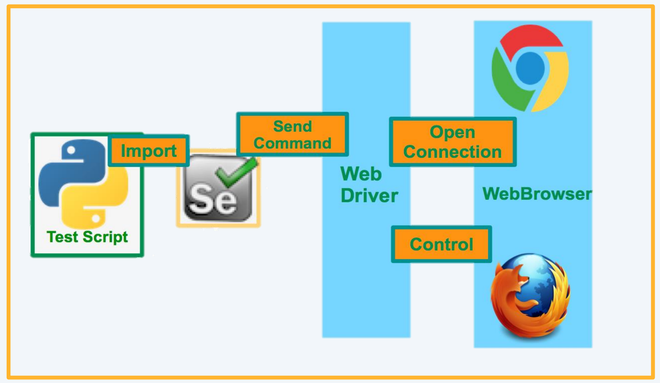

Figure1:Web Browser Automating Framework

Experimental Results

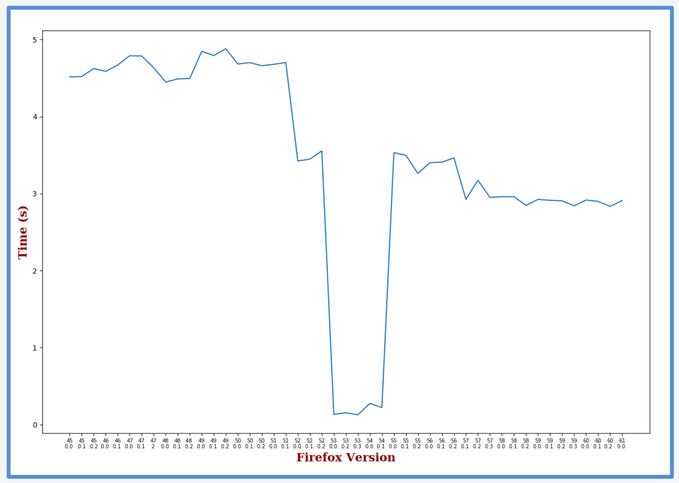

Figure 2:Page Load Time for Cisco URL

- In the above Figure, the dip in the graph that occurs between version 53.0 and 54.0.1 could be due to the addition or removal of a new feature from the browser.
- The load times are the mean of four different tests.

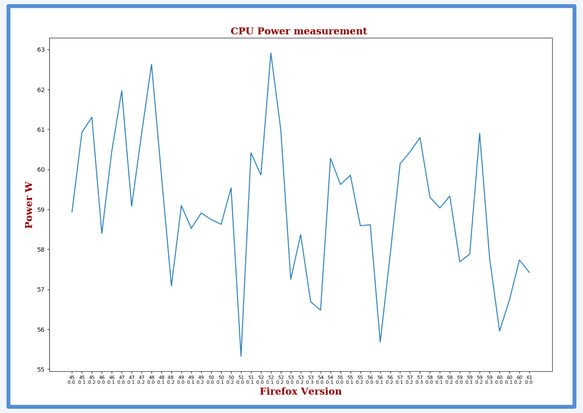

Figure 3:CPU Power Measurements

- As shown in Figure 3, the FF-51.0.0 consumed less CPU power, but page load time was longer.
- There is no consecutive improvement in CPU power consumption in these versions.

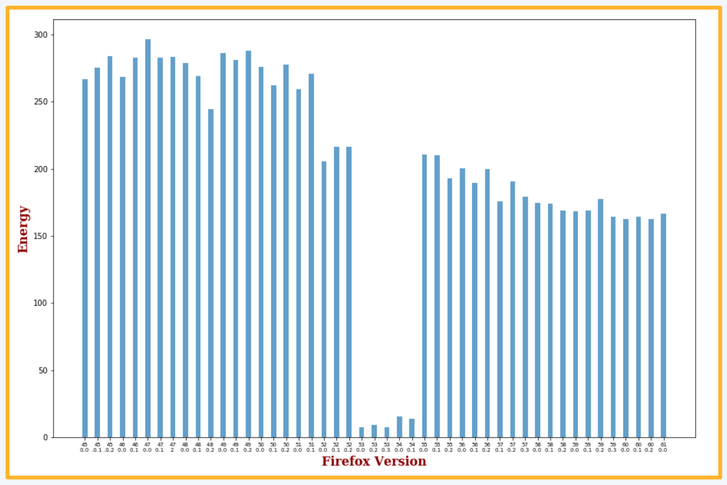

Figure 4: Firefox Energy Consumption

- Figure 4 shows the energy consumption which was calculated as power from the Figure 3 multiplied by the load time from Figure 2.
- Version 61.0.0 which is the most recent one we tested, is not an efficient version compare to other (53.0.0).
- Figure 4 shows a direct correlation between energy consumed related to PLT and CPU-PM.

Conclusions

The most Recent versions		The Best 3 Firefox		The Worst 3 Firefox	
FF-Version	Percentage of saving	FF-Version	Percentage of saving	FF-Version	Percentage of saving
61.0.0	-60.0385	53.0.2	94.6525	59.0.2	-77.9195
60.0.2	-65.3508	53.0.3	95.3946	57.0.1	-72.7972
60.0.1	-70.3136	53.0.0	95.5939	57.0.3	-71.9251

Table 1: Summary of Firefox Energy Saving

- We infer that each browser release handled web content (Ajax, HTML) in different ways.
- Firefox versions require significant enhancement in their energy consumption.

References

1. I. Manotas et al., "An Empirical Study of Practitioners' Perspectives on Green Software Engineering," 2016 IEEE/ACM 38th International Conference on Software Engineering (ICSE), Austin, TX, 2016, pp. 237-248.
1. E. Jagroep et al., "Awakening Awareness on Energy Consumption in Software Engineering," 2017 IEEE/ACM 39th International Conference on Software Engineering: Software Engineering in Society Track (ICSE-SEIS), Buenos Aires, 2017, pp. 76-85.
2. C. Pang, A. Hindle, B. Adams and A. E. Hassan, "What Do Programmers Know about Software Energy Consumption?," in IEEE Software, vol. 33, no. 3, pp. 83-89, 2016.

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Contact:hsadeveloper@gmail.com