search input field on the Google page[6]. At the time of our assessment, there are at least two text input fields stacked onto each other for search box. It appears that one field is responsible to display suggestions in gray color and the other one is used for actual user input. It utilizes the CSS mechanism of z-value to advise the browser to render the actual input field in front of the other, which is not detectable in naive DOM node extraction. One has to do additional CSS property look-ups in order to find the text input field to be filled by keyboard. It is not just sufficient to check the z-value, since there may be multiple *real* text input fields and some covered ones, which are not accessible to a user but share the same z-value. At present we do in-depth investigation to resolve such issues for popular websites, however a universal solution is required to deal with these scenarios.

Additionally a major challenge arises from single CSS values, as they are not directly observable by the available Mutation Observer. Currently, we are able to track changes of the assigned CSS classes. An elaborate solution would be to fork the Blink engine code that handles the DOM tree, and cooperate native callbacks into the Render Process when any CSS value of a DOM node of interest is changed.

4. EVALUATION AND CONCLUSIONS

We conducted an experimental evaluation to quantify the performance and usability of the proposed system. We used OptiKey [1] as a benchmark, which is a state of the art open source tool for gaze interaction using the conventional approach of mouse and keyboard emulation by eyes. Eleven participants (4 female, 7 male) took part in the study, and they were asked to perform common browser tasks such as search, navigate, bookmark [5]. Tasks were identical for both systems, and the dwell time was configured to one second to negate any bias between the system. Eye movements were tracked with SMI REDn remote eye tracker with a sampling frequency of 60Hz, which was attached to the front of a 24 inch monitor. The experimental results indicate that the proposed system performs consistently better than OptiKey in not only task accomplishment, but also in terms of usability and cognitive load measures. The average time required to complete the specified task by proposed system was 252.18 seconds, significantly better than 424.15 second required for OptiKey (p-value 0.0023). Furthermore, in the SUS usability analysis our system reached the average score of 83.86, which is considered to be highest grade in SUS guidelines[7], while the OptiKey's score of 57.96 is well below the standard average. The participants also felt significantly less workload (measured by NASA-TLX test[8]) in the proposed system with an average score of 43.0, compared to OptiKey's score of 54.5.

The presented Chromium based framework offers the significant prospect of including gaze interaction in Web applications. Hence the user could perform all essential browsing operations by gaze in an easy and effective manner, as shown by the usability evaluation of our eye-controlled browser. We are currently working on further enhancements to include sophisticated gaze interaction features such as secure login/password entry, and better Web video interaction by customizing native HTML5 controls. The proposed framework comprises an extendable architecture, and in future we want to enhance its usability with additional modalities, i.e., integrating emotions into the browsing experience [8].

[6] `https://www.google.com`
[7] `http://www.measuringu.com/sus.php`
[8] `https://www.nasatlx.com`

5. ACKNOWLEDGMENTS

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