Testing the temporal accuracy of keystroke logging using the sound card

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BACKGROUND

- Writing research has seen an increased use of keystroke logging
- Keystroke logging programs log the writing process in a continuous and non-obtrusive way
- They enable researchers to collect fine-grained data because they log every keystroke in relation to a timestamp (in milliseconds), which indicates the time that a specific key was used.
- For the researcher interested in for example word-internal processing it's important to know the degree of precision and accuracy that can be achieved by the program.

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METHOD

- We propose a method of measuring the accuracy of keystroke timestamps using a *recording of the sounds* made by key presses.
- Sound cards fit the purpose well since they typically have much better *temporal resolution* than computer keyboards and they are *readily available* in most computers

- Key presses produce noise patterns that are *easily temporally located* in an acoustic waveform.
- The timestamps of the noise patterns can then be compared with the corresponding timestamps reported by the keystroke logging program.
- Specifically, the differences between the two timestamps of each keystroke, provides an estimate of the accuracy of the program.

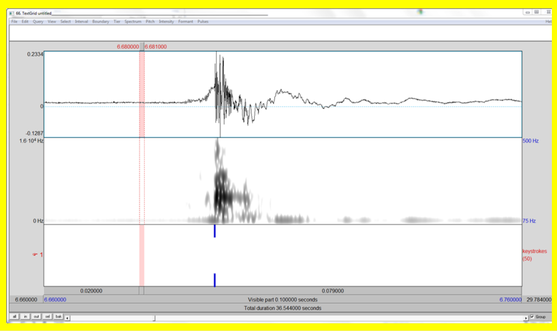
EXPERIMENTS

- We tested the accuracy of different keystroke loggers, including the latest version of the keystroke logging program ScriptLog as well as two prototypes of a new ScriptLog version implemented in C++ and Java respectively.
- Due to the increased use of web-based written communication another keystroke logger was implemented in Javascript, and ran in a recent version of Firefox.
- Each test case consisted of 50 key presses of the 'space' bar, and was run on identical hardware and operating system.

TECHNICAL SETUP

- Windows XP, Dell Latitude E6500 (2008), Dell USB keyboard (2010)
- Recorded by sound card Creative SoundBlaster Connect (2008) at 32000 Hz, Praat, Windows 7, Dell computer (2010), 'Digital' headset
- Noise location points located by visual inspection of spectrogram calculated with a 0.001 length window. Visibility was limited to 0.1s and 16000 Hz on a 1470px wide view so pixel density was 14.7px/ms.

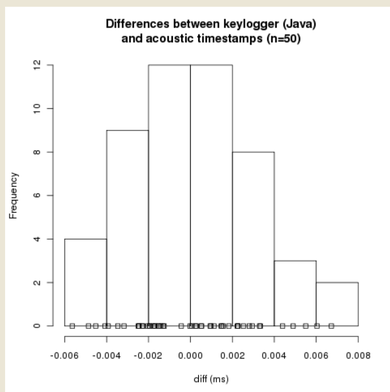
IDENTIFICATION OF A KEY PRESS NOISE BURST



RESULTS

	point-by-point[1]			interval[2]		
	sd[3]	range[3]	maxdiff[3]	sd[3]	range[3]	maxdiff[3]
ScriptLog	0.005	0.023	0.012	0.007	0.028	0.015
JavaScript prototype (Firefox)	**0.003**	0.012	0.006	**0.004**	0.017	0.011
Java prototype	**0.003**	0.012	0.007	**0.004**	**0.014**	**0.008**
C++ prototype	**0.003**	**0.010**	**0.005**	**0.004**	0.016	0.009
SoundCard[4]	5.29E-05	0.0002	0.0001	8.75E-05	0.0002	0.0001

[1]**point-by-point** compares the individual timestamps of one keystroke.
[2]**interval** compares the length of the interval between two consecutive keystrokes.
[3]**sd** is the standard deviation of the distribution of all differences between a program-measured and sound-measured timestamp. **range** and **maxdiff** are other properties of this distribution.
[4]this tests the accuracy of the sound card with a sine wave at 377 Hz + some noise.



- We find significant differences between the variances of the prototypes and ScriptLog (example: for Java: $F=0.287$, $p<0.001$)
- This implies that a reimplemented version will provide improved timing accuracy
- This method can be implemented as part of any keystroke logging program in order for the user to test the accuracy in his/her own computer environment.

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