

GestureCalc: An Eyes-Free Calculator for Touch Screens



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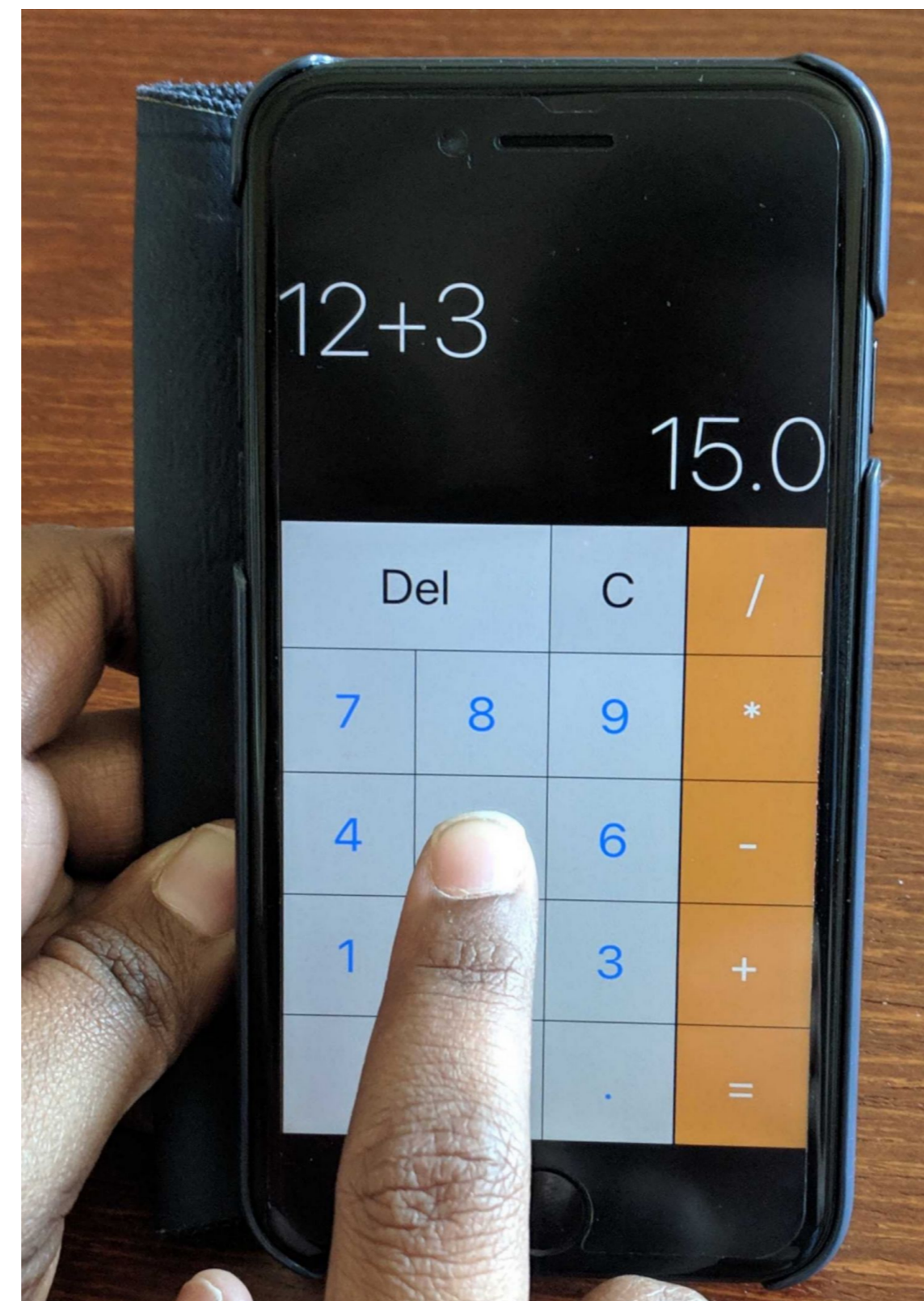
Richard Ladner

GestureCalc

GestureCalc is an eyes-free, target-free four-function calculator app for touch screens.



Typing "5" on GestureCalc. The gesture can be performed at any location on the screen.



Typing "5" on a traditional touch screen calculator by locating the button labeled "5".

Character Codes

Digit Codes

- 0 one-finger downward swipe
- 1 one-finger tap
- 2 two-finger tap

- 3 three-finger tap, then downward swipe (3 + 0)
- 4 three-finger tap, then one-finger tap (3 + 1)
- 5 three-finger tap, then two-finger tap (3 + 2)
- 6 three-finger tap, then three-finger tap (3 + 3)

- 6 (alternate) one-finger upward swipe, then one-finger downward swipe (6 + 0)
- 7 one-finger upward swipe, then one-finger tap (6 + 1)
- 8 one-finger upward swipe, then two-finger tap (6 + 2)
- 9 one-finger upward swipe, then three-finger tap (6 + 3)

- . one-finger long tap (hold down until phone vibrates)

Design Principles

Eyes-Free

Accessible to blind and low-vision people.

Target-Free

Input gestures can be performed at any location on the screen, as recommended by [1].

Prefix-Free

No character code is the prefix of any other character code. This is important so that the system can tell where one character ends and the next begins.

Based on metaphors, not print characters

Rather than relying on print characters, GestureCalc relies on metaphors such as "up is more, down is less". as recommended by [1].

Learnable

Digit codes are based on DigiTaps [2], whose design focuses on learnability.

[1] Shaun K. Kane, Jacob O. Wobbrock, and Richard E. Ladner. 2011. Usable Gestures for Blind People: Understanding Preference and Performance. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11)*.

[2] Shiri Azenkot, Cynthia L. Bennett, and Richard E. Ladner. 2013. DigiTaps: Eyes-free Number Entry on Touchscreens with Minimal Audio Feedback. In *Proceedings of the 26th Annual ACM Symposium on User Interface Software and Technology (UIST '13)*.

Operator Codes

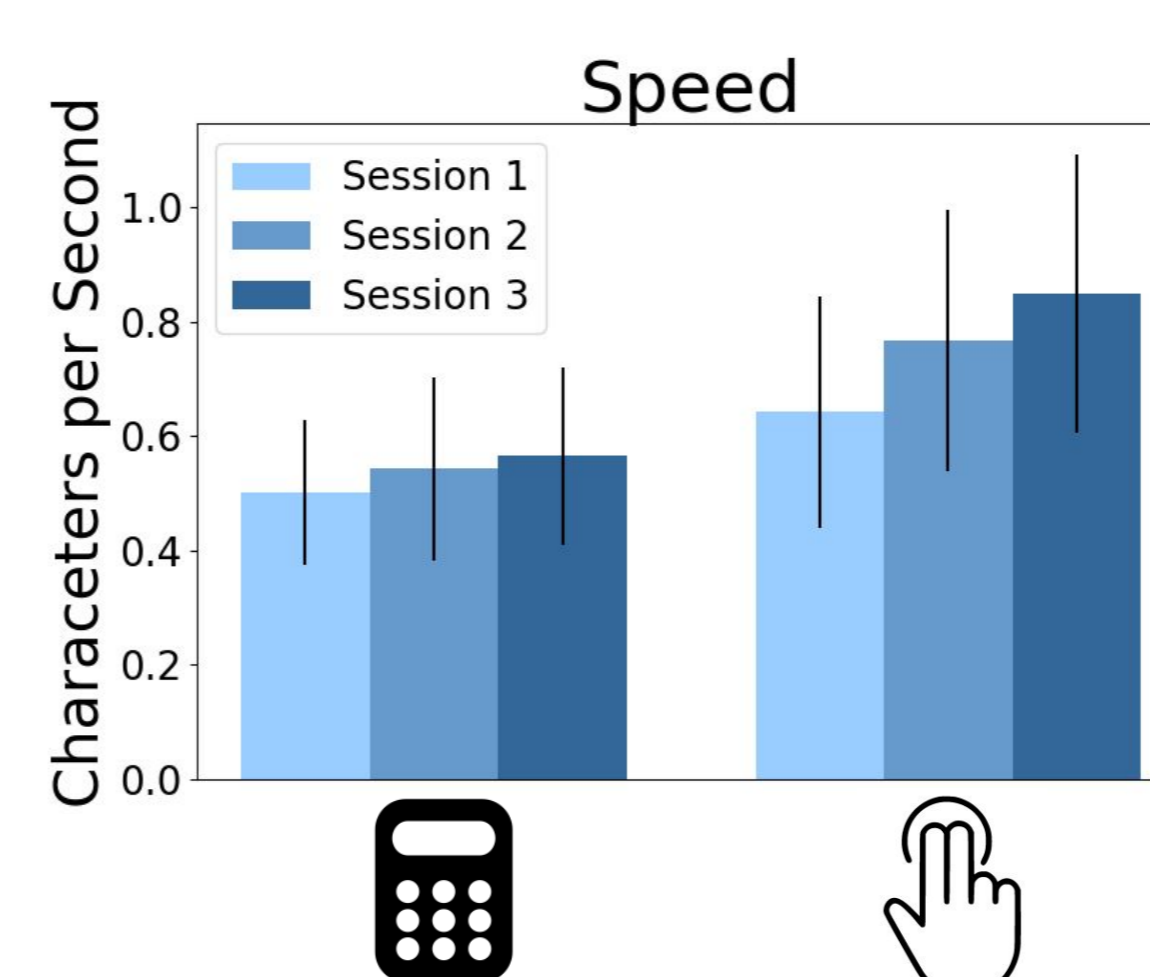
- + two-finger upward swipe
- two-finger downward swipe
- * three-finger upward swipe
- / three-finger downward swipe

- = two-finger rightward swipe

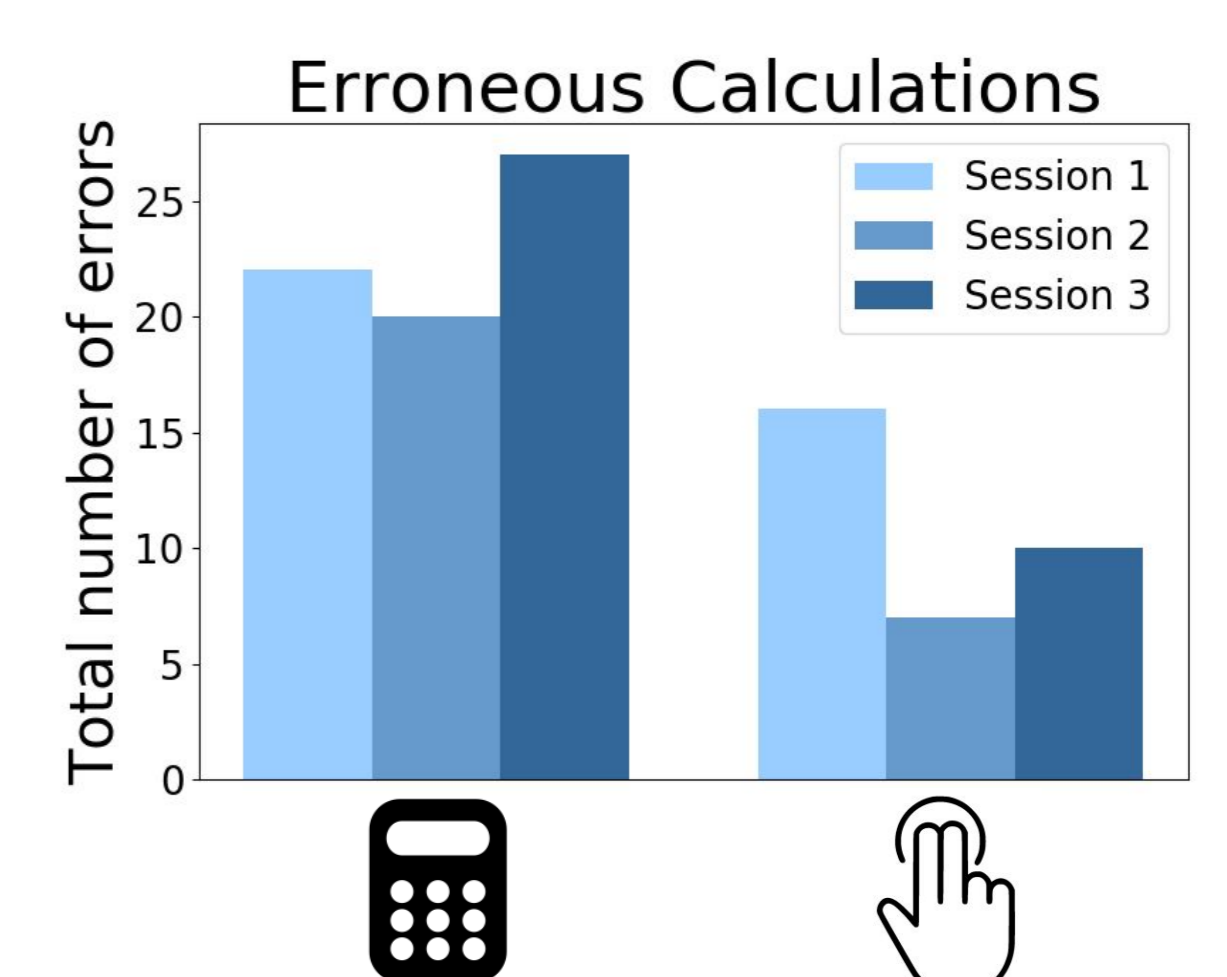
- Delete one-finger leftward swipe
- Clear all two-finger leftward swipe

Evaluation

- Participants: 8 screen reader users
- 3 hour-long sessions
- 2 techniques
 - GestureCalc
 - ClassicCalc (Baseline): a traditional touch screen calculator with Voiceover



Speedup: 40% faster with GestureCalc than ClassicCalc



Error Reduction: 52% fewer erroneous calculations with GestureCalc than ClassicCalc

Open Source on GitHub

github.com/bindita/GestureCalculator



Read our full paper for more details!