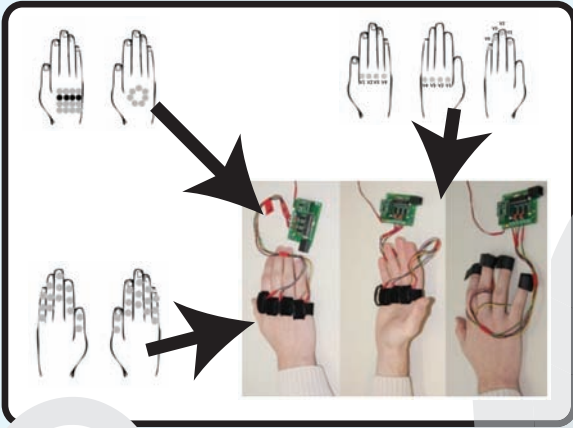


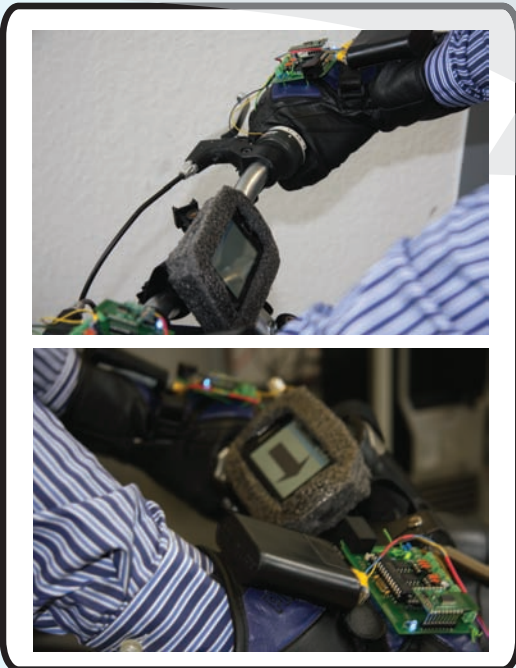
Enhancing Outdoor Navigation Systems through Vibrotactile Feedback



2

Pre-User Study to inform the Design

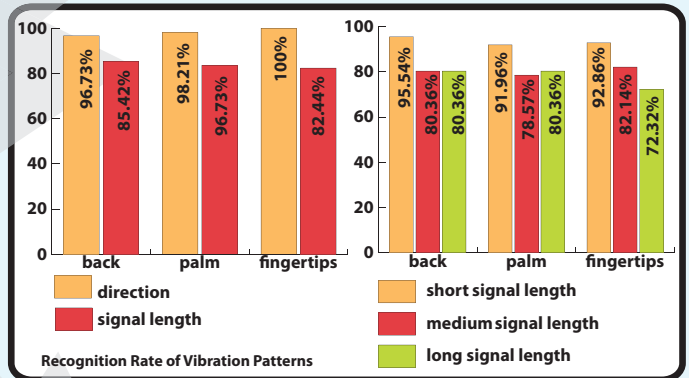
- linearly moving signal along the back of the hand, the palm, and along the fingertips
- actuator's vibration duration, the pause time between two consecutive pulses at different actuators, and the number of moves were controlled
- three different signal lengths: short (300ms-vibration time / 150ms pause), medium (600ms / 200ms), long (900ms / 250ms)
- participants were asked to identify the direction and the length of the signals on the right hand



Idea - Supporting Motorcyclists' Navigation with Vibrotactile Feedback

1

- riding a motorbike requires a high degree of attention
- commercial navigation systems use predominantly visual or auditory channels to communicate with the driver
- navigation systems for motorcyclists are often a mere adaptation of in-car navigation systems
- do not take different user needs or environmental requirements into account



Testing with 2 Motorcyclists and 2 Cyclist under Real Driving Conditions Turning Left and Right

3

Tactile: The short vibration pattern was extended so that the direction was shown on both hands simultaneously. The signal went from left to right or right to left on each hand. Moreover, all actuators were switched on for 1.5 seconds before the actual short signal. This should indicate an upcoming pattern.

Visual: During visual no other feedback was provided but an image with an arrow pointing left or right on the display. The arrow was shown for 8 seconds before it disappeared again.

Combined: Combined made use of tactile and visual. First, an image with an arrow is shown. Then, after 2 seconds, tactile is started. All in all, combined lasted for 8 seconds.

Results

- participants enjoyed using vibration feedback and visual output as a combined technique
- participants mentioned problems using audio feedback while navigating
- headphones worn under a helmet stated to be painful