Tongue-Computer Interface Technology - Heuristic Evaluation

1. MISSION STATEMENT

We envision an interface that stays inside the mouth, hidden either behind the teeth or in some not easily visible location. This interface interacts with the tongue and enables it to control a variety of technologies wirelessly. As an interface that stays within the mouth, we anticipate cleaning requirements; like contacts or retainers the interface may be removed or cleaned on a frequent basis.

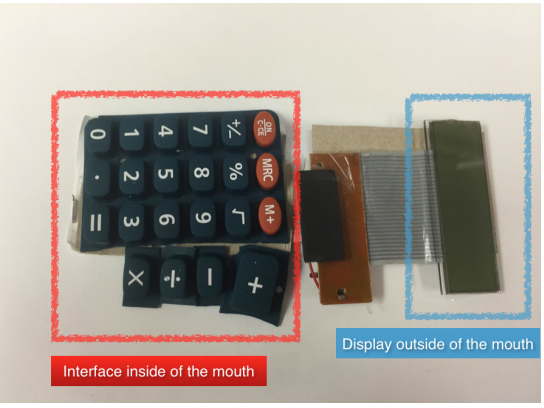
In this heuristic evaluation report, we aim to summarize the prototypes we developed to shape this interface and the different reactions people had when testing it. It is important to mention that at no point do these prototypes represent the final expected result, but it gives an impression of the particular task we aim to test. The three tasks were: 1) being able to locate buttons with the tongue, 2) being able to perform operations by pressing those buttons with the tongue, and 3) fitting a well sized artifact inside the mouth comfortably.

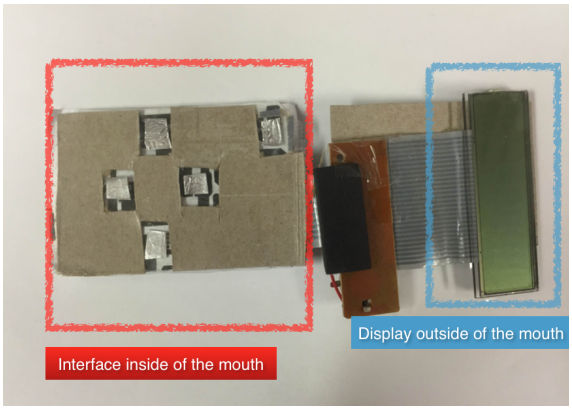
2. PROTOTYPES

To prototype our tongue-controlled interface, we created two sets of prototypes; one set to asses the haptic function of button pressing using a modified calculator, and another to asses the form of the interface inside the mouth. Both prototype sets were meant to rest against the top of the mouth and interfaced by the tongue from below. Please note that the different versions of the prototypes were designed based on users' feedback (detailed in point 3):

Prototype 1 - Calculator

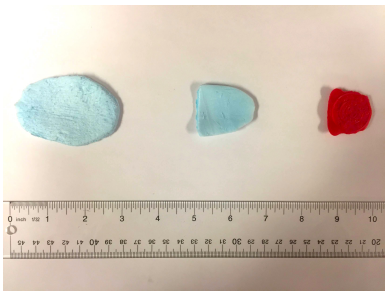
A cheap $4 calculator was used to test the ability of users to perform operations with their tongue. The idea behind it was to ask users to press different buttons and see based on the results of the scree if their input was correct. This would give us an idea of how easy it is to control a button set inside the mouth.





VERSIONS 1 AND 2 OF THE CALCULATOR-BASED PROTOTYPE

Prototype 2 - Stuffs forms



The stuffs prototypes were used to address the sensation of a user having something in his mouth designed to be used for longer periods of time. This would give us an initial impression of what it might feel like to use our tongue-interface technology.

It also gave us, the designers, an impression of how complicated it might be to fit the buttons to be handled by the user within the constraints of the shape of the mouth without being uncomfortable.

3. SUMMARY OF HEURISTIC EVALUATION RESULTS AND PROTOTYPE REDESIGN PROCESS

Prototype 1 - Calculator

Version 1 was constructed from a full portable calculator. The prototype was wrapped in plastic, with the button portion being placed in the person's mouth. The designer asked the person to press certain buttons or perform certain operations and the person attempted to do so. Participants complained about the large size; some people could barely fit the keypad into their mouth. Furthermore while the buttons were easy to push by hand, they were difficult to push by the tongue. Buttons towards the back of the keypad were hardest to push, as participants found it difficult to reach towards the back of their mouth. Buttons were easiest to press in immediate circumference around the center of the keypad.

Version 2 attempted to address these concerns by reducing the size of the keypad and reducing tactile load required to press the buttons. The the keypad was folded and clamped with tape, and the buttons were replaced with conductive metal slats. These slats enabled a button press with a gentle tap of the tongue.

Prototype 2 - Stuffs Prototypes

Version 1 attempted to create a thin, less defined form as a staring base to understand how big we could make the form within the confines of the mouth. This first guess proved to be too big to reasonably fit in the mouth. When used it looked like a blue tongue sticking out of the mouth.

Version 2 reduced the size and profile of version 1 according to one of our participants feelings on sizing. After an initial trial, the form was curved to better fit the curvature of the mouth. This form fit with adequate space, and the participant felt like they were able to comfortably reach the majority of exposed real estate. The two most prominent complaints were 1) the prototype was not attached to the top of the mouth and would sometimes float around and 2) it did not include an identifiable buttons and therefore left the interface mapping up to the imagination.

Using the form factor of version 2, version 3 was created with a button and control layout. It has not been tested with participants yet, although a small test by one of the designers yielded that the buttons were recognizable by the tongue quite well despite their small size, and that some of this interface should be streamlined with less number of elements and more distinct elements to individual touch.