Towards a Portable, Affordable Tactile Display

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***Abstract*— This work-in-progress project describes the evolution of a design for a small form factor, affordable tactile display using simple, easily obtainable motors and mechanical linkages. Performance characteristics of each display are given, as are plans for experimental validation of their potential to support visually impaired smartphone users.**

The European Commission Horizon Prize for the development of an affordable, high resolution tactile display was launched in 2017 [1]. Despite many entries, this prize went unawarded after none of the proposals met the Commission's standards for performance and affordability [2].

One of the key barriers to reducing the cost of tactile displays is the cost and complexity of integrating thousands of tactile elements to make up a full page display. Previous work [3], [4] has shown that fingertip-style tactile displays have the potential to present a visually impaired user with useful tactile information at a fraction of the size, weight and cost of a full-page display. Below, this concept is exploited in the evolution of an affordable, highly portable, mechanically actuated tactile display.

The Tactile Mouse is an initial 'proof-of-concept' device intended to demonstrate the principle of offering the user a 'tactile window' into a larger piece of tactile media. The device offers an 8x8 taxel (tactile pixel) fingertip display, with 1.5mm diameter pins spaced 2.5mm apart. Each taxel has a maximum vertical travel of 1mm and vertical resolution of 10 μm, enabling the presentation of both Braille and tactile graphics. Movement of the mouse, tracked with an optical flow sensor, allows the user to explore the tactile media in space. The downward-facing camera can capture printed text and graphics, which can be represented physically in real-time. The prototype measures 150x82x65mm including space for a 6600mAh battery, supporting 5-8 hours of use.

The Tactile Smartphone Case refines this concept to serve a particularly enticing application for a fingertip sized tactile display - a tactile smartphone attachment [5]. A miniaturised mechanism has been devised using oval cams to transfer rotary motion from miniature DC motors (heavily geared to provide sufficient torque to displace the user's skin). This reduces the display size to 5x6 taxels but allows the whole assembly to sit above the screen/camera of a smartphone, with overall dimensions of 59x30x30mm.

The tactile smartphone case will use motors geared to 100rpm and oval shaped cams to deliver a maximum (worst case estimated) taxel response time of 0.3 seconds. The taxel spacing remains the same as the Tactile Mouse, conforming to the UK Braille Standard, with the maximum vertical travel reduced to match the standard 0.5mm dot height [6].

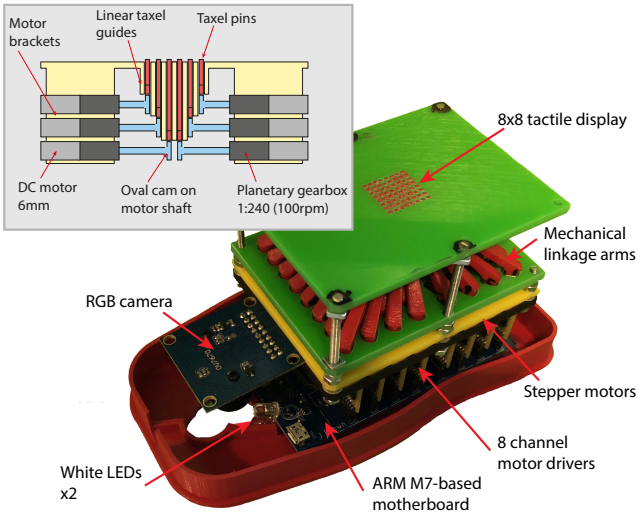

Fig. 1. Figure: The Tactile Mouse interface (uncased). Insert: The proposed miniaturised System for a Tactile Smartphone Case

Future work will explore the limits of human memory and perception to interrogate the validity of the tactile window method of exploring a virtual tactile stimulus. Experiments will also evaluate the effectiveness of the proposed interfaces in various smartphone based tasks such as examining photographs, exploring maps and directions and reading printed text.

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