

DEFINING THE PRE-EXAMINATION EXPERIENCE OF MRI PATIENTS THROUGH AFFECTIVE INTERACTION



Figure 1: (UN_DEFINED) in the context of pre-examination of MRI

BACKGROUND

For many patients, Magnetic Resonance Imaging (MRI) experiences are uncomfortable and associated with high levels of anxiety and stress. Such negative experiences may interfere with image quality and increase examination time (Crosswell & Lockwood, 2020). It is therefore necessary to understand the mental states of the patients prior to the examination in order to provide stress-relieving measures through information or a simulated experience. The most common approach for measuring patients' experiences in this context is self-reported questionnaires (e.g., STAI-6), but these methods of evaluation can be perceived as intrusive (van Minde & Weda, 2014) and only reflect mental states that patients are aware of (Semmer & Elfering, 2003). The purpose of this exploratory study is to develop a 'designerly' tool for measuring mental states in the context of MRI experiences and explore the suitability of various sensors to differentiate between mental states such as relaxed or stress.

DESIGN PROCESS



Figure 2: Design process of a) 100 sketches of measuring MRI experience through interaction, b) exploratory prototypes based on a selection of sketches, c) high fidelity prototype incorporating sensors and d) ideation of round shape and string integration



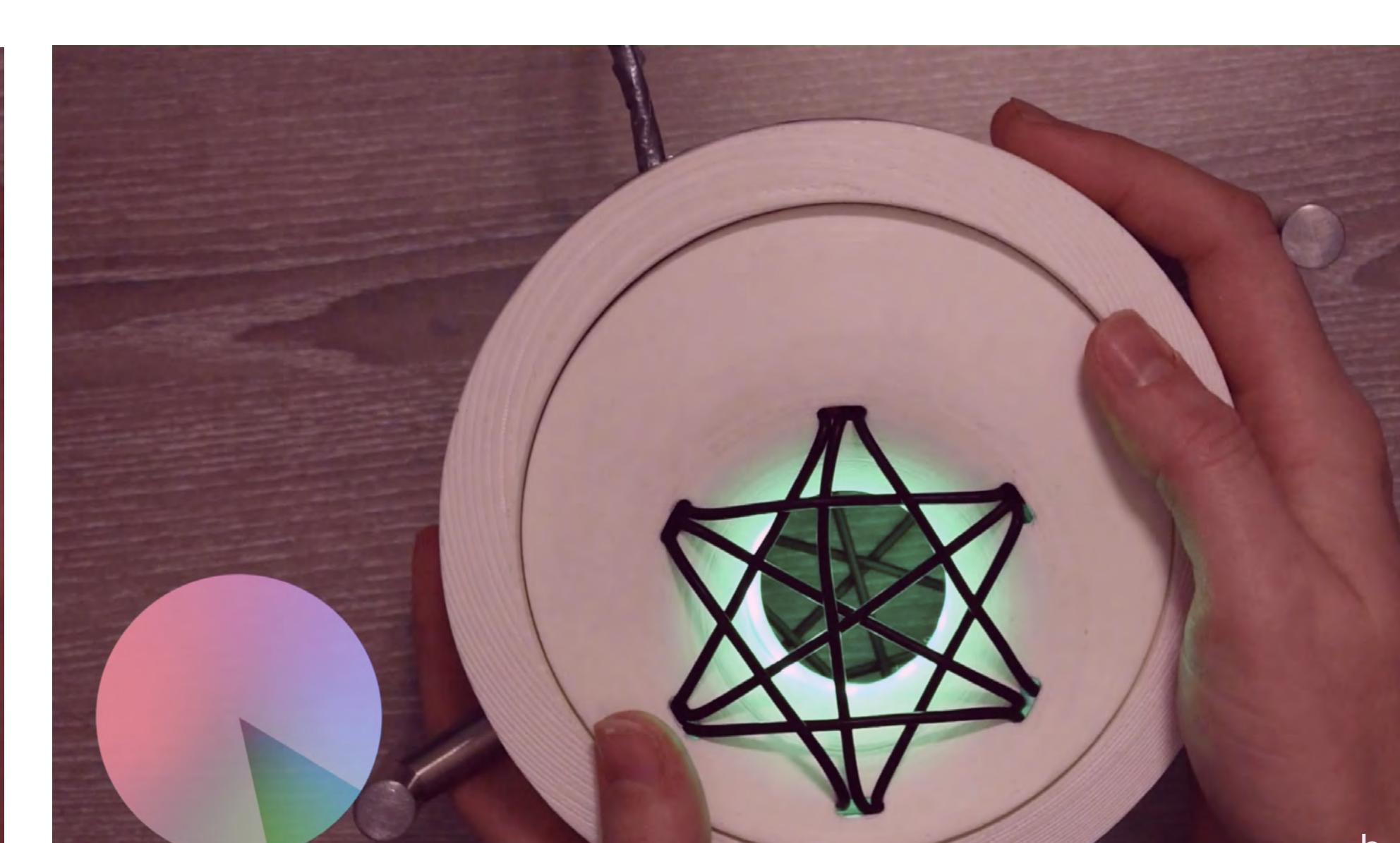
Figure 3: (UN_DEFINED) Prototype

Through this iterative design process, we developed (UN_DEFINED), a sensing design object that elegantly measures the emotions of MRI patients through manipulation and functional interaction (Figure 3). When interacting with the object, patients set their MRI ambience preferences such as ambient colours and sounds (Figure 4). (UN_DEFINED) uses sensors detecting hand movements and gathering physiological data for the possibilities of pattern recognition analysis. Inspired by Philips design, it seamlessly blends into the Philips Ambient Experience by combining affective expression with ambiance personalization.

The philosophy of the form is that at the core of (UN_DEFINED) emotions are hidden through veils of strings. The interaction with the strings is the gateway to measuring and influencing emotions visualized by the core. The name (UN_DEFINED) implied the possibilities for interaction and functionality.



Figure 4: The mapping of interaction to personalized ambient settings of (a) sounds and (b) colours.



METHODS

With an aim to interpret the relation between mental states and interaction through data gathered by various sensors, a user test was conducted in a controlled lab environment, where participants (N = 9) performed a series of interactive tasks with the artefact. Intervention tasks were randomly assigned to evoke either a relaxed or stressed mental state, which was followed by a repetition of the interactive tasks for comparison purposes. Natural interaction data was gathered by various sensors including an accelerometer-gyroscope and stretch sensors. Information about unconscious hand movements and intentional interactive behaviour was extracted through signal processing. Qualitative insights included observations of their behaviour and a debriefing interview about their experience.

FINDINGS

We observed individual differences in interaction patterns from collected data, indicating the necessity of creating a baseline for individuals. Based on qualitative assessment, namely interviews and arbitrary inspection of the processed sensor data, we believed that stressed participants displayed quicker and more erratic hand movements. We validated the interaction design of the artefact through the interviews and observations, leading to relevant insights regarding the mapping of output to various features.

DISCUSSION

Our final contributions to the research field of health technologies are the following:

- A 'designerly' sensing artefact that collects interaction data that is validated on the areas of interaction design and data collection through a small user study.
- A dataset containing sensor data, gathered in an experimental research setup.
- The notion that a baseline is necessary for recognizing mental states through sensor data.

Some major limitations acknowledged in this study require future examination. Firstly, it was difficult to relate the sensor data to the video recordings due to an unclear starting point which led to limited analysis of the semantics of the sensor data. Due to the small sample size, the data is not generalizable. Nonetheless, it still led to valuable insights that could be validated in a more extensive and narrowly focused future research.

The future iteration of our concept should focus on the possible methods to create baselines and improve the sensing abilities by including physiological sensors.

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