A Survey and Thematic Analysis Approach as Input to the Design of Mobile Music GUIs

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ABSTRACT
Mobile devices represent a growing research field within NIME, and a growing area for commercial music software. They present unique design challenges and opportunities, which are yet to be fully explored and exploited. In this paper, we propose using a survey method combined with qualitative analysis to investigate the way in which people use mobiles musically. We subsequently present as an area of future research our own PDplayer, which provides a completely self contained end application in the mobile device, potentially making the mobile a more viable and expressive tool for musicians.

Keywords
NIME, Mobile Music, Pure Data

1. INTRODUCTION
As mobile phones have increased in processing power, there has been an explosion in mobile music research and performance, and the release of commercial apps [4], [18]. The mobile phone can be considered a computer, one that is sufficiently powerful enough to carry out signal processing in real time. The signal processing cores of interactive music platforms like Pure Data and Supercollider run on mobiles in the form of libraries [15]. These developments, in industry and in research, have taken place rapidly and organically. While many apps exploit new interface capabilities of the mobiles, few successfully address the specific limitations of the mobile and its form factor. In this light, the mobile is not just a small computer, but is a type of musical platform unto itself with specific sets of affordances and constraints. To design interfaces for these systems, it can be useful to understand the potential end user, and their expectations and experiences of mobile music making.

We propose a survey-based study-method to define the needs for screen interfaces to mobile music instruments. We draw upon user centered design (UCD) methodology from HCI practice, a family of qualitative and ethnomethodological methods that include the end user in the design process. Established UCD methods include ethnographic interviews, structured brainstorming, scenario building, participatory design workshops, and user studies. Surveys are one such method that is used at the outset of a design exercise to gauge user needs and understand existing usage. Thematic analysis can then be applied to extract emerging themes across the survey dataset, to structure and codify themes to inform the design of an interactive system. We report on a study that we conducted that includes an online survey and a resulting GUI framework for Pd on mobile devices.

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2. RELATED WORK
HCI methods have been broadly applied as inputs to the design and as on evaluation of the outputs of NIME instruments. There has been a greater overall emphasis in the evaluation of NIME instruments and interfaces.

The importance but relative lack of evaluation of NIME instruments has been discussed by Stowell et al. [21]. They raise questions of how to evaluate the uses and affordances of new musical interfaces and compare the user experience of the designed system based between free and guided use of the interface. Johnston [14] proposes a broader study for the evaluation in order to understand the creative practice in a performer's use of a NIME. Using techniques from grounded theory for data analysis and focusing on user experience studies, he proposes a theory of musician-interface interaction through experimental analysis. Beilharz et al. [5] approach user experience evaluation through task completion studies, interviews and questionnaires. Their findings indicate the necessity of user evaluation studies in order to fill the gap between user expectations and designers' intentions especially in their context of wearable interfaces where the expression with the interface itself is highly subjective. Fabiani et al. [9] look at the evaluation of a mobile system using a survey based questionnaire, across a diverse range of users followed by a controlled lab based experimental evaluation.

Evaluation methods from HCI research have been adapted to explore the creative affordances of NIME instruments. Gelineck and Serafin [11] apply questionnaire and usability tests with simple musical tasks and propose a musical task-based method for investigating the comparative creative affordance of different basic control interfaces such as knobs and faders. Wanderley and Orio [23] present several methods for the evaluation of input devices and propose alternative musical tasks that are that demonstrate the usability of the controller; such as learnability, explorability, feature controllability and timing controllability. They aim to create simple guidelines for the performance evaluation of input devices. This evaluation methodology is not applied in a musical performance context but rather as a means to measure user intentions in the control of a musical interface. In the study of performances, Zappi et al. [24] used a questionnaire method to ask the audience evaluate a participatory audio-visual performance.

User centered design and participatory design are established methodologies in HCI that consult end-users and involve them in the design process of an interactive system. Bau et al. [3] used interview, structured brainstorming, and scenario building methods to inform the design of a novel auditory display device. Essl [8] used design methodology to create an audio programming environment specific for the mobile.

NIME instruments are more typically created for specific musical projects or in a particular compositional context and tend not to consult a broad user base to gauge needs as an input to design. Whether the resulting interfaces are evaluated or not, this tendency risks to limit the usability and generalizability of NIME instruments. Through focusing on broad and general issues of mobile music practices in our own survey and using techniques of thematic analysis, we hoped to be able to distill some of the key design issues for contemporary mobile music practices.

3. METHODS

Thematic analysis is an approach that allows researchers to identify emergent topics not explicitly stated in survey questions. The theoretical framework is based on organizing key issues in data and grouped under themes reflecting important relations in the research questions. Thematic analysis should not conceptualize themes directly as answers for the overall research question but rather serve to frame key topics that involve specific descriptions in relation to the question [7].

We conducted an online survey for the period of three weeks using Survey Monkey [22]. The survey was publicized on mailing lists and forums geared towards music technology practitioners and institutions; such as Auditory, New Interfaces for Musical Expression (NIME) community, Sound and Music Computing (SMC) network etc. In this survey we aimed to find out the ways in which people have been using mobiles musically: for instance, as free-standing instruments, standalone portable studios, gestural controllers for laptops. We also wanted to understand the types of problems and challenges they might encounter as they transposed their practices honed on desktop or laptop computers to mobile devices. Additionally, we wanted to know how they imagined mobiles being used musically in the future.

The survey was anonymous and was comprised of 19 multiple choice questions that covered the following topics:

- Musical experience
- Computer programming experience
- Types of mobile musical usage (e.g. composition, production, performance)
- How usable and musical respondents found mobile music apps
- Whether the mobile felt like an instrument and musically “expressive”

Alongside the multiple choice questions were a series of open-ended questions, requesting textual responses. These gave more room to respondents to refer to their personal experience. After gathering the results, the quantitative data was tabulated and the textual responses were collated for further qualitative analysis. This broad thematic analysis was intended to identify emerging themes and enable us to understand respondents concerns, in particular those that we hadn’t predicted or prompted by our own questions.

4. RESULTS

We gathered 226 surveys, 177 of which were completed (a completion rate of 70.5 %). The gender balance of respondents was 81.8% (180) male and 18.2% (40) female. 6.8% (15) participants were under the age of 24, 42.6% (94) were in the 25-34 age group, 31.2% (69) in the 35-44 age group and 19.5% (43) over the age of 45.

We asked the participants about their programming and musical expertise. When asked if they were a musician, 19.7% (42) responded 'no', 8.5% (18) 'beginner', 36.2% (77)'amateur' and 35.7% (76) 'professional'. When asked if they had any experience as programmers, 9.8% (20) replied 'not at all', 29.8% (61) 'a little', 26.8% (55) 'quite a lot' and 33.7% (69) 'very much'.

Our multiple-choice questions asked respondents about the different ways in which they might use the phone musically. 32.8% (64) used the smartphone in live performance, 32.8% (64), used music game apps and 24.1% (47) used a smartphone as a portable studio for composing music, whilst 43.1% (84) did not use their smartphones for making music.

18.4% (18) of those who had used instrument-like apps on the iPhone found they felt ‘not at all’ like an instrument, 55.1% (54) found they felt only 'a little' like an instrument; 19.4% (19) found them 'quite a lot' like an instrument and 7.1% (7) found them ‘very much’ like an instrument. When asked whether the smartphone provided an interactive musical experience, 2.4% (2) replied ‘not at all’, 38.6% (32) replied ‘a little’, 28.9% (24) replied ‘quite a lot’, and 30.1% (25) replied 'very much’ .

The smartphone was a regular part of the performance set up of 28.7% (27) of the users who had performed with it. Only 8.3% (8) of participants who used portable studio type apps had actually finished a complete song on it.

56.5% (52) users used the smartphone in conjunction with a computer for music making. Nonetheless, 79.3% (73) respondents could imagine using a smartphone musically without a computer. We asked respondents how they used the sensor capabilities of the smartphones for musical purposes: 91.9% (79) used the touchscreen, 59.3% (51) used the accelerometer, 51.2% (44) used the microphone, 19.8% (17) used the camera and 14% (12) used the proximity sensors. We asked about some of the collaborative and interactive aspects of mobile music making. 56.8% (46) used the smartphones musically in collaboration with others. When asked whether they felt like they were interacting with others through the smartphone, 11.8% (4) said ‘not at all’, 23.5% (8) ‘only a little’, 52.9% (18) ‘some’ and 11.8% (3) ‘very much’.

5. ANALYSIS

The hybrid structure of the survey, with multiple choice and open-ended questions provided flexibility for us to apply a qualitative analytic method for analysis. Within the thematic analysis methodology, we looked the recurrence of certain issues in the answers, that included: limitation of the touchscreen, lack of consistency in sensor input, latency, networked possibilities, toy-like music applications, etc. Looking at how these issues mapped on to the practice of music making and by combining them in groups allowed us to identify high-level themes: “Frustration to Potential", "Workflow" and "Expressivity". At a higher level, the respondents were addressing the forms of interaction afforded by the mobile devices intuitively without demonstrating knowledge of or directly citing the theory of affordances. These responses could be categorized broadly in two areas - interaction centered around the device and its form factor, and interaction focused around the communicative, or social capabilities of the mobile phones. We then went back to the survey results and extracted related data with specific questions, through the lens of the main themes, allowing us to organize responses to different questions thematically, eliciting a potential narrative that was not prescribed by the design of the survey questions. Elemental units of study such as sensor interaction, usage paradigms, form factor, and unrealized

potential, come together as related themes linked to musicality that become points of discussion within the context of a high level thematic analysis method.

5.1 Modes of Musical Interaction

5.1.1 Device Interaction

Device interaction relies on the input capabilities of the embedded sensory systems of the mobile and enables multiple ways of using mobiles for making music. Sequencing with real-time control of parameters is mentioned as one of the most common modes of musical interaction in our survey; both in the category of composing and gaming with music applications. This mode of musical interaction is linked to touchscreen-based control interfaces, and device interaction was often described as problematic in terms using of this touchscreen interface for editing within many mobile music applications. Instrument-like applications were often referred to as being 'just toys' in the survey. Users reported serious limitations and lack of precision due mainly to latency issues and GUI problems and pointed to many interface design issues. However, for those who did use their smartphones as independent instrument, sensor capabilities, portability and mobility all emerged as positive aspects of the devices.

'remarkable: possible to make expressive gestures, advantage: small form factor, limitations: no haptic feedback' (59)

Interaction with these instrument-like applications might result in developing new gestural libraries for mobile devices: it is mentioned in the survey that they produce new ways of interacting with the device. We were also interested that one of the main demands of future design in mobile music applications was to enable more "creative ergonomy", embracing what is unique and what comes naturally in interaction with these devices. Simply transplanting traditional conceptions of 'real world' instruments and emulating them in the design of musical applications did not fulfill the expectations for how mobiles could be used as musical instruments.

'I would prefer to use something that treats the devise as in interface in its own right and uses gestures/controls more natural to it than trying to play a tiny piano' (31)

'I think we want to get away from traditional interfaces like keys, strings, and even knobs and sliders as much as possible and be more abstract, while still maintaining a sense of some kind of intuitive system.' (8)

We found that for many the main interest in using smartphones musically was for exploring alternative options for gestural control in live performances. Sending sensor input data via wireless networks to computers - generally running Max MSP or Ableton Live - was the most common way of using smartphones in live performance.

'Smartphones for us at this point are partly instruments but mostly controllers for Ableton' (2)

However, reliability of the wireless connection in such real-time performances was questioned. In a programming context, device interaction was found to be highly limited in terms of input bandwidth, screen size, CPU speed, lack of pressure sensitivity and even suggestions of dynamic screen texture. It was also mentioned that these types of limitations could also be an advantage, creating focus on honing interaction. Mostly, rich library resources and quick iteration cycles were found by respondents to be advantages of programming on smartphones.

'What an enormous pain. Has anyone heard of snippets? Give me back my keyboard!'(4)

5.1.2 Social Interaction

In a musical context, mobiles retain many of their social-interaction aspects. This is not only through their embedded network features and their basic affordances as communication devices. Many music apps can become systems that allow designers to enable and promote various notions of social interaction in music making. As some respondents mentioned in the survey, the mobile opens opportunities for interaction in a collaborative context. Most of the respondents who replied to our question on participation and interaction mentioned that mobiles enabled the potential for networked interaction, as a possible platform for synchronized performances both locally and remotely.

'We have performed as a mobile phone orchestra to explore and research the smartphone as NIME's [...] advantages include these devices being close to their owners in their daily lives.' (33)

'Networking possibilities potentially offer synchronized performance both locally and globally.' (138)

Besides potentially making music creation more social, networked features also make it possible to share the created content and be part of online communities: social interaction can be integrated at many different layers in practice. A mobile application can enable a user to create music, connect that user to a network to collaborate musically or to receive online peer critique, and in the final stage it may allow the user to distribute the piece through social networks. This social experience also brings up a new forms of musical engagement that potentially allow for a democratizing of the multiple aspects of music production and distribution. The respondents also stressed how the interaction design of the applications affected the human-human interaction in music collaboration. It is mentioned in the survey that much interaction requires the performer to look at the device in order to play it, affecting any musical interactions, which require eye contact between performers.

'difficult to keep eye contact without physical controllers (sense of touch)' (25)

Other respondents pointed to the social affordances of mobiles, resulting from the combination of mobility, commonality and network features, as they suggested:

'Probably the best use for mobile is in real-time audience participation' (39)

'The network capabilities could enable [people coming] to a concert being able to download an app and build their own loops in synch with the concert.' (127).

6. Adaptive Interfaces

Screen real estate and workflow issues combine to define limiting factors in musical expressivity of mobiles. We propose an app with a hybrid GUI system that uses an adaptive graphical display rendering a runtime graphic interface on the premise that musical activity on the mobile is more focused on performance than on programming.

Mobile interface design provides unique design challenges, different from many of the challenges of computer-based interface design, and has been the subject of previous CHI Workshops [17], and conferences in its own right (MobileHCI). One of the problems of designing for mobile is considering how to represent desktop and laptop user interfaces on the smaller mobile devices. Mori and Paternò, [16] and Bandelloni

et al [2] look at the problems with resizing user interfaces to function on mobiles, proposing a 'semantic redesign' which transplants the actual functionality of webpages to mobiles. Gupta et al [12] approach this problem through representing webpages as multilevel hierarchies, and Hattori et al [13] propose a method of segmenting webpages for representation on mobile screens.

The small form factor, in particular the size of mobile screens (a consistent concern that emerges throughout our own survey), is a key design a challenge. Some work looks at improving existing paradigms, such as Robbins, Lee and Fernandez [19], who examine different workflow and GUI integrations on mobile devices and present a novel GUI method. Similarly, Findlater, Wobbrock and Wigdor [10] look at the issues inherent to touchscreen typing and propose more ergonomic layouts for touchscreen keyboards. Roudaut, Lecolinet and Guiard [20] propose expanding input bandwidth through discriminating amongst subtly different thumb gestures. Benko, Wilson and Baudisch [6] look at two finger gestures techniques for pixel-accurate selection on larger touchscreens and tabletop displays, honing techniques for 'pinch' and other gestures.

7. Conclusions and Future Work

Since the mobile is not ideal for programming, and as the attraction of the mobile is for small, gestural touchscreen instruments to be used in performance situations, we propose a mobile application that divides the mobile music workflow into composition and performance modes.

This mirrors the Edit and Playback modes of Max MSP or Pure Data. In our proposed solution, Edit mode takes place on the computer (GUI development) with Playback mode only on the mobile (GUI use). We demonstrate an implementation this proposed system using Pure Data, libPD, and Open Frameworks.

The proposed workflow allows the musician to develop custom patches in the way they are accustomed to using a graphical programming paradigm while authoring on the computer. The renderer allows the musician to deploy her patch on the mobile "automatically" with no additional development steps and no additional technical knowledge required. The result is a functional interface of sliders and buttons that recalls the original patch, running on the mobile touchscreen interface.

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