An analysis of mid-air gestures used across three platforms

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ABSTRACT
This study aims to compare the use of specific mid-air gestures across platforms (Microsoft Kinect, Leap Motion and Myo Armband) in order to identify the most recurrent gestures and their functions within the interface. 250 applications were analysed and 15 common gestures were mapped within this study. Results will contribute to wider research on mid-air gesture-based interfaces and assistive technology.

Categories and Subject Descriptors
• Human-centered computing~Human computer interaction (HCI) • Human-centered computing~Gestural input • *Human-centered computing~Interaction techniques*

Keywords
Mid-air gestures; Gesture based interaction; Freehand interaction.

1. INTRODUCTION
Gesture-based interaction methods are increasing in popularity due to the expansion of low cost platforms such as Microsoft Kinect, Leap Motion, Myo Armband and many other sensors that enable computer interaction through mid-air gestures.

Gestural interactions have been called “intuitive” and “natural” by many authors over the years and have grown as a promising step in HCI. Literature [1][2][3] suggests that gestures, a natural way of human communication, offer advantages over conventional interaction paradigms and have the potential to diminish barriers between users and computer interfaces.

However, there is a lack of standard practice and well-defined frameworks to guide the design and evaluation of interfaces based on mid-air gestures.

This study aims to compare the use of specific mid-air gestures across different applications and platforms in order to identify the most recurrent ones and establish a well-defined set.

Results will be useful to direct future user studies and will contribute to further discussions about the design, evaluation and improvement of mid-air gesture based interfaces.

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2. METHODS
Three platforms (Microsoft Kinect, Leap Motion and Myo Armband) and their respective applications were evaluated in order to check which gestures are used across platforms and which ones are more likely to recur.

250 most downloaded[1] [2] [3] (top ranked) mid-air gesture-based applications were analysed in this study, including those specifically developed for Microsoft Kinect[1] (58), Leap Motion[2] (184) and Myo Armband[3] (8). Only free "ready to play" apps were included in the final list, therefore, imbalance in the number of apps analysed for each platform is due to availability of free apps for these platforms.

Applications included different categories such as games (129), education (21), music (21), experimental (38) and computer navigation (41). Data about the gestures used in individual apps was gathered directly from the official app stores[1] [2] [3] for each platform and the analysis included demo testing, video and textual description data provided by each app.

The gestures used within each application were identified, and classified as 1) for navigation 2) for selection and 3) to trigger specific action in the application’s context.

3. PRELIMINARY RESULTS
15 gestures were identified as the most common and recurrent ones across the three platforms. As figure 1 shows, pointing (cursor based) is the overall most recurrent gesture and it is present in 134 (53.6%) of all 250 applications. Waving (used in 34.4% of applications) and swiping (used in 20.4% of applications) are also commonly used gestures across platforms.

Myo Armband enables a limited set of gestures, resulting in more consistent use of gestures across the apps (figure 1). On the other hand, Leap Motion enables a wider range of gestures and hence, there is a greater variability in the gestures that are used across apps.

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[1] Microsoft Kinect*: http://windows.microsoft.com/en-us/windows/search#q=kinect+for+windows&s=Store*
[2] Leap Motion*: https://apps.leapmotion.com/*
[3] Myo Armband*: http://developer.thalmic.com/downloads*

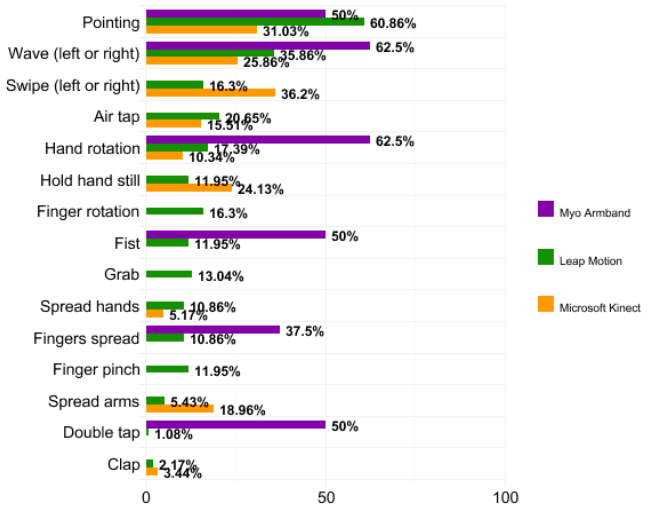

Figure 1. Percentage of apps for each platform that uses each mid-air gesture.

Gestures involving fingers and hand movements are less-commonly used in apps for Microsoft Kinect due to its current limitations on hand-tracking.

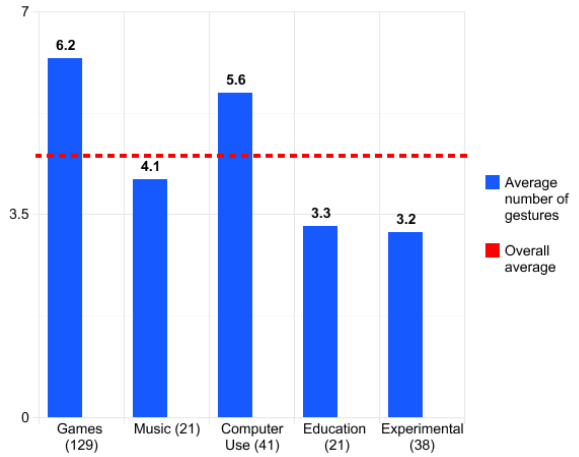

Figure 2. Average number of gestures present across different types of apps

As shown in figure 2, some types of applications are more likely to use a wider range of gestures than others. Across all apps, the mean number of gestures used in an app was 4.48, with games using the highest number of gestures (mean = 6.2) and experimental apps using the lowest (mean = 3.2).

These differences arise from particularities of each type of application and their respective users, interface and context. For example, an education app usually is more focused than a game which is a much more immersive environment that allows gestures bigger in number and complexity.

4. DISCUSSION AND FUTURE WORK

Results show that the most recurrent mid-air gestures are those that already are well-established as standard gestures for touch-based interfaces (e.g. pointing, waving, swiping, tapping). There is a translation of touch-based elements to mid-air interaction and developers seem to prefer to continue using these standard sets. However, further studies are needed to investigate if this is the most appropriate approach with regards to performance and user engagement.

Although some gestures commonly have a well-defined role across platforms (e.g. pointing and swiping for navigation, air tapping and finger pinch for selection), other gestures present a divergent role among the analysed apps and are used to trigger different actions across interfaces. Thus, future studies about gestural interaction practices and the use of a standard set of gestures is advised.

These results will be directly used to define future user studies within a wider research project on mid-air gesture-based interaction for older adults and individuals with disabilities, contributing to the field of HCI and future applications.

5. ACKNOWLEDGMENTS

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