LITERATURE SURVEY

1 SYSTEMATIC LITERATURE REVIEW OF HAND GESTURES USED IN HUMAN COMPUTER INTERACTION INTERFACES

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Gestures, widely accepted as a humans' natural mode of interaction with their surroundings, have been considered for use in human-computer based interfaces since the early 1980s. They have been explored and implemented, with a range of success and maturity levels, in a variety of fields, facilitated by a multitude of technologies. Underpinning gesture theory however focuses on gestures performed simultaneously with speech, and majority of gesture based interfaces are supported by other modes of interaction. This article reports the results of a systematic review undertaken to identify characteristics of touchless/in-air hand gestures used in interaction interfaces. 148 articles were reviewed reporting on gesture-based interaction interfaces, identified through searching engineering and science databases (Engineering Village, Pro Quest, Science Direct, Scopus and Web of Science). The goal of the review was to map the field of gesture-based interfaces, investigate the patterns in gesture use, and identify common combinations of gestures for different combinations of applications and technologies. From the review, the community seems disparate with little evidence of building upon prior work and a fundamental framework of gesture-based interaction is not evident. However, the findings can help inform future developments and provide valuable information about the benefits and drawbacks of different approaches. It was further found that the nature and appropriateness of gestures used was not a primary factor in gesture elicitation when designing gesture based systems, and that ease of technology implementation often took precedence.

2 TOUCHLESS COMPUTER INTERFACES IN HOSPITALS

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The widespread use of technology in hospitals and the difficulty of sterilising computer controls has increased opportunities for the spread of pathogens. This leads to an interest in touchless user interfaces for computer systems. We present a review of touchless interaction with computer equipment in the hospital environment, based on a systematic search of the literature. Sterility provides an implied theme and motivation for the field as a whole, but other advantages, such as hands-busy settings, are also proposed. Overcoming hardware restrictions has been a major theme, but in recent research, technical difficulties have receded. Image navigation is the most frequently considered task and the operating room the most frequently considered environment. Gestures have been implemented for input, system and content control. Most of the studies found have small sample sizes and focus on feasibility, acceptability or gesture-recognition accuracy. We conclude this article with an agenda for future work. Healthcare associated infections (HCAIs) are a major problem. In the United States, HCAIs cause 99,000 attributable deaths and cost US$6,500,000,000 every year.1 In Europe, they result in 16,000,000 extra days spent in hospital, 37,000 attributable deaths and €7,000,000,000 in cost every year. 1 Modern technology can contribute to patient care by allowing healthcare staff rich and immediate access to patient information and imaging. However, computers and their peripherals are difficult to sterilize effectively, and keyboards are natural breeding grounds for various pathogens. 2 In order to reduce the spread of HCAIs, hospitals must implement multimodal strategies, including such measures as provision of anti-bacterial gels, ongoing hand hygiene training and education, and proper equipment sterilisation and cleaning. However, when a healthcare worker (HCW) washes their hands, it is unlikely that 100 per cent of pathogens are eliminated.3 As such, a simple and effective solution for preventing contamination of surfaces by people's hands, and of people's hands by surfaces, is to remove the need to touch those surfaces at all during use. Given the wide spread use of technology in hospitals, interacting with computer-based systems using touchless interaction may be helpful for reducing opportunities for contamination. Touchless control of computers has become more common in recent years. The most important factor facilitating this progress has been the introduction of more reliable and affordable consumer grade hardware, particularly time-of-flight (ToF) cameras such as the Microsoft Kinect. It is thus appropriate at this point to examine the literature to

assess the current state of the art and to identify where further efforts should be directed.

3 GESTURES FOR PICTURE ARCHIVING AND COMMUNICATION SYSTEMS (PACS) OPERATION IN THE OPERATING ROOM: IS THERE ANY STANDARD?

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Objective Gestural interfaces allow accessing and manipulating Electronic Medical Records (EMR) in hospitals while keeping a complete sterile environment. Particularly, in the Operating Room (OR), these interfaces enable surgeons to browse Picture Archiving and Communication System (PACS) without the need of delegating functions to the surgical staff. Existing gesture based medical interfaces rely on a suboptimal and an arbitrary small set of gestures that are mapped to a few commands available in PACS software. The objective of this work is to discuss a method to determine the most suitable set of gestures based on surgeon's acceptability. To achieve this goal, the paper introduces two key innovations: (a) a novel methodology to incorporate gestures' semantic properties into the agreement analysis, and (b) a new agreement metric to determine the most suitable gesture set for a PACS. Materials and methods Three neurosurgical diagnostic tasks were conducted by nine neurosurgeons. The set of commands and gesture lexicons were determined using a Wizard of Oz paradigm. The gestures were decomposed into a set of 55 semantic properties based on the motion trajectory, orientation and pose of the surgeons' hands and their ground truth values were manually annotated. Finally, a new agreement metric was developed, using the known Jaccard similarity to measure consensus between users over a gesture set. Results A set of 34 PACS commands were found to be a sufficient number of actions for PACS manipulation. In addition, it was found that there is a level of agreement of 0.29 among the surgeons over the gestures found. Two statistical tests including paired t-test and Mann Whitney Wilcoxon test were conducted between the proposed metric and the traditional agreement metric. It was found that the agreement values computed using the former metric are significantly higher ($p < 0.001$) for both tests. Conclusions This study reveals that the level of agreement among surgeons over the best gestures for PACS operation is higher than the previously reported metric (0.29 vs 0.13).

4 A COMPARISON OF GAZE-BASED AND GESTURE-BASED INPUT FOR A POINT-AND-CLICK TASK

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Alternative input devices to the computer mouse are becoming more affordable and accessible. With greater availability, they have the potential to provide greater access to information for more users in more environments, perhaps while also providing more natural or efficient interaction. However, most user interfaces are built to be mouse-driven, and the adoption of these new technologies may depend on their ability to work with these existing interfaces. This study examined performance with gesture-control and gaze-tracking devices and compared them to a traditional mouse for a standard Fitts' point-and-click task. Both gesture-controlled and gaze-tracking proved to be viable alternatives, though they were significantly slower and more taxing than the familiar mouse. In order to make effective use of these devices, researchers, designers, and developers must find or create control schemes which take advantage of the alternative devices' benefits while curtailing the drawbacks. The ever-present computer mouse has been a staple of computing for many years. This remains true even as the number devices grows to unprecedented levels. Cisco (2014) reports that 526 million mobile devices and connections were added in 2013, with smartphones accounting for 77 % of the growth. They predict that by the end of 2014, the number of mobile connected devices will start to exceed the number of people, and by 2018 there will be 1.4 mobile devices per capita. As more devices are added and integrated into work and play, more data is being generated as is the need to access it. Alternatives to the mouse have been created and suggest the possibility of more intuitive interfaces to provide better access for a variety of populations. Other devices solve more specific problems, such as allowing access to data in sterile environments, overcoming physical handicaps, and exploring big data. Sterile environments exist for users in surgical settings, where accessing a keyboard and mouse would require rescrubbing, a process that can take significant time and is critical to patient safety. Alternate input devices such as vision-based interfaces, have the potential to create more accessible devices for users living with disabilities.