

# Using Augmented Reality to Assist Seated Office Workers' Data Entry Tasks

Heejin Jeong<sup>1</sup>, Ankit Singh<sup>1</sup>, Myunghee Kim<sup>1</sup>, and Andrew Johnson<sup>2</sup>

<sup>1</sup>Department of Mechanical and Industrial Engineering, <sup>2</sup>Department of Computer Science  
University of Illinois at Chicago

## ABSTRACT

The data entry task is one of the common office tasks performed in the seated position that can be assisted by augmented reality technology. The paper introduces an ongoing project to develop an AR-based data presentation interface to assist office workers' data entry tasks. The interface developed in this project was designed to facilitate the transition between the two steps including reading data and typing the data into a computer system using a keyboard. Usability evaluation is conducted in a controlled experiment with human subjects to examine whether the AR-based data presentation interface improves data entry performance and mitigates office workers' physical and mental workload.

**Keywords:** Office work, augmented reality, data entry, human factors.

**Index Terms:** Human-centered concepts [Human computer interaction (HCI)]; Interaction paradigms—Virtual reality; Human-centered concepts [Human computer interaction (HCI)]; Visualization—Empirical studies in visualization

## 1 INTRODUCTION

A wide range of augmented reality (AR) technologies have been applied to assist human tasks in manufacturing and education domains [1, 2]. However, few AR studies have been conducted in an office environment, although the office may be the most common place where humans need assistance. The project presented in this paper started from a question, "how can the AR technology be used as a task assistant tool in office workplace?"

Most office workers seated in their workplaces spend time on data entry. The data entry is an ordinary but a critical day-to-day human task, which requires two steps to complete: (1) to take handwritten data from paper documents and (2) to enter/type the data into computer systems using a keyboard and/or a mouse. Many studies have investigated risk factors of the task for the traditional data entry operators. Yu and Wong (1996) found that frequent users of visual display units had significantly more musculoskeletal problems in the neck and shoulder due to the repetitive heads-down and heads-up movements [3]. McLean and Urquhart (2002) found that there were more typing errors in the data entry task when they have difficulties with concentration [4].

In this paper, we introduce an ongoing study to investigate the effect of augmented reality display on data entry performance and human operator's physical and mental workload. We work on this project to examine the two hypotheses: The AR-based data presentation interface improves data entry performance (H1), and

mitigates office workers' physical and mental workload (H2). We investigate these hypotheses on the reasoning that the traditional way of data entry with papers requires continuous up and down neck motions and head orientations. This may lead to various neck and back disorder, thus we aim to alleviate it through our AR head-up data presentation method.

## 2 METHODS

A data presentation interface was developed using a wearable AR head-up display. A human-subject experiment is being conducted to evaluate the data presentation interface. In our study, we aim to present our subjects with information through three interfaces: a paper (baseline), an extra monitor, and an AR device. Subjects are then instructed to access the information through these interfaces and input the information into an online form. The form is presented to them on a separate computer system. The location of the interface varies from left, right and top of the monitor for both AR and extra monitor modes of information presentation. For information presented to subjects through paper, it is in the traditional, below the keyboard location. We recruit normal and non-professional typists for our study who have moderate to low experience in typing. The task time to enter the information from one of the interfaces to the computer system is around 5-7 min, depending upon the typing speed of the individual subject.

### 2.1 AR-based Data Presentation Interface development

The data presentation interface developed in this study was designed to facilitate the transition between the two steps of the data entry task by displaying the handwritten images through the augmented environment. Using a Magic Leap app, Gallery that allows uploading scanned image files via its Cloud Library, handwritten images were displayed in front of the users (Figure 1).

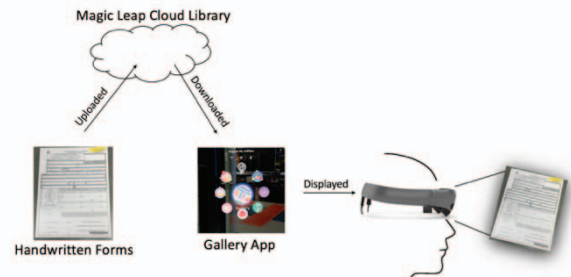


Figure 1: Interface development process.

\* email: heejinj@uic.edu

## 2.2 Evaluation

The AR-based data presentation method is compared with two traditional data presentation methods: 1) taking handwritten data from the original paper document placed on the table which is the same surface as the keyboard (a paper; baseline), 2) taking data from the electronic document displayed on the additional computer monitor screen next to the monitor for typing (an extra monitor).

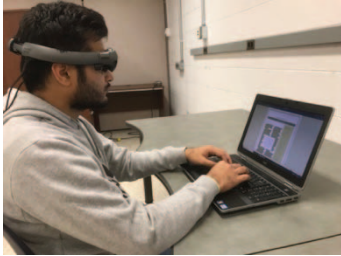


Figure 2: Interface evaluation.

To control confounding in this experiment, we created handwritten data that have three different levels of legibility (low, medium, high), based on handwriting legibility scale [5], and distributed them between subject groups. There are multiple measures to evaluate the AR-based data presentation interface, including data entry task performance (e.g., task completion time, accuracy), physical load (e.g., via electromyography, head/neck motion) (Figure 2), the NASA-TLX is used as a subjective measure of workload [6]. Additionally, we collect users' subjective ratings on how much the use of each method is helpful, easy to use, and preferred. Also, we seek users' opinions and suggestions to improve the usability of the current AR-based data entry interface.

## 3 CONCLUSION

This paper outlines an ongoing project to develop and evaluate an AR-based data presentation interface that can help office worker's data entry tasks. AR could be a solution to the problems of the traditional data entry method. The developed AR-based data presentation method would minimize the head movement of the operator for information access while data entry. Moreover, the new interface would subsequently help to reduce physical discomfort and disorders of office workers. We continue to work on this project to examine the two hypotheses.

## REFERENCES

- [1] A. Y. Nee, S. K. Ong, G. Chryssolouris, and D. Mourtzis. Augmented reality applications in design and manufacturing. *CIRP annals*, 61(2), 657-679. 2012.
- [2] M. Akçayır and G. Akçayır. Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review*, 20, 1-11. 2017.
- [3] I. T. S. Yu and T. W. Wong. Musculoskeletal problems among VDU workers in a Hong Kong bank. *Occupational Medicine*, 46(4), 275-280. 1996.
- [4] L. Mclean and N. Urquhart, N. The influence of psychological stressors on myoelectrical signal activity in the shoulder region during a data entry task. *Work & Stress*, 16(2), 138-153. 2002
- [5] A. L., Barnett, M. Prunty and S. Rosenblum. Development of the Handwriting Legibility Scale (HLS): A preliminary examination of Reliability and Validity. *Research in developmental disabilities*, 72, 240-247. 2018.
- [6] S. G. Hart and L. E. Staveland. Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research. In *Advances in psychology* (Vol. 52, pp. 139-183). North-Holland. 1988.