Available online at www.sciencedirect.com

ScienceDirect

Procedia Manufacturing 3 (2015) 566 – 573

Procedia MANUFACTURING

6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015

A study on the human factors for a smart cart system

Min Kyu Kim, Eun Young Lee, Yoon Seok Chang*

Ubiquitious Technology Application Research Center, School of Air Transport & Logistics, Korea Aerospace University, Goyang city, 412-791, Republic of Korea

Abstract

In this research, we introduce a smart cart system which helps workers to perform an efficient picking operation without human errorsor cost problems. Despite having searched for other relevant reviews, we could not find other published researches concerning the angle of cart handle during the dynamic movement and pick-by-cover. Thus we focused on human factors for a smart cart system affecting work performance and convenience.This experiment surveyed and was conducted using 31 participants. First, we surveyed on which location of touch screen (i.e. 250mm and 450mm from cart handle) was more comfortable in relation to human body parts. Secondly, we asked participants which angle of handle (i.e. vertical, 45° tilted and horizontal) was most comfortable,again in relation to body parts. Lastly, participants were asked which picking method among pick-by-cover and pick-to-light was more convenient during experiment. The results revealed that 80.6% of participants preferred a distance of 250mm from the cart handle and 41.9% of them preferred a 45° tilted handle. Also, 71% of participants felt comfortable with the pick-to-light system and that it was more efficient and comfortable taking into consideration performance time as well as quality. We believe that this research will provide a good guideline for smart cart design as well as various options for designing smart cart.

*Keywords:*Smart cart system;Handle angle;Touch screen distance;Pick-to-light;Pick-by-cover

* Corresponding author. Tel.: +82-3158-2074; fax: +82-2-3158-2044.
*E-mail address:*yoonchang@kau.ac.kr

doi:10.1016/j.promfg.2015.07.267

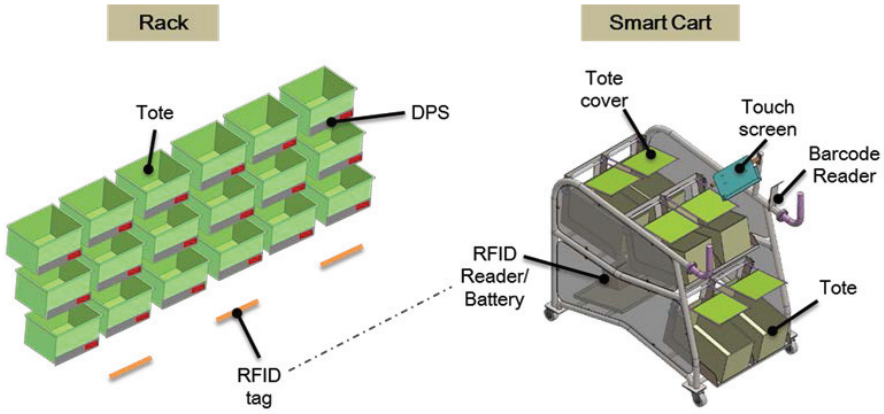

Fig.1. Smart Cart System.

1. Introduction

Picking activities in warehouses usually consist of moving, lifting, picking, placing and other work, which are repetitive and physically challenging. To improve work efficiency, various automation picking equipment systems (e.g. Goods to Destination System and Automatic Picking System) have appeared. But a considerable number of companies can't afford to get those automation equipment systems due to cost reasons. Instead, they perform picking tasks using Digital Picking System (DPS) and Digital Assorting System (DAS) most commonly. However using these machines, workers turn their waists continuously because the DPS and DAS layouts are only designed to improve machine performance without taking into consideration human factors. If one worker deals with multiple orders, he/she faces some difficulty. For example, when a worker passes by a rack and picks several items from rack to complete an order, he/she must return to the front of the rack and perform picking tasks until all orders are completed. On the other hand, if a worker deals with multiple orders at the same time, the possibility of human error might increase.

Thus, we have introduced the Smart Cart System for picking and put-away operations which take into consideration both work efficiency and convenience. The system consists of a touch screen, barcode system, RFID system, totes module, cart module, and other optional systems as seen from figure 1. A Worker pushes the cart with 6 totes to rack, and an RFID reader embedded under the cart scans the RFID tag on the floor for acquiring location information. If there are some items to be picked at the location, the DPS light turns on and the tote cover to put the item opens automatically. The Touch screen shows the item information including the quantity at that time. Once the worker sees the light, they stop and pick the item after reading the barcode. Then tote cover is then closed. This is a smart cart system designed to minimize human errors and tasks when a worker deals with multiple orders. In this research, we investigate the location of touch screen, the angle of handle and compare the pick-by-cover to pick-to-light in order to help workers focus on their work without being physically demanded and confused.

This paper is organized as follows: Section 2 reviews relevant researches. Section 3 describes how to experiment various options. Section 4 presents the results of the experiment. Lastly, we discuss about the results and suggest recommendations in Section 5.

2. Relevant research

There have been many researches in cart system/design, display configuration, pick-by-vision system and body parts discomfort survey as in Table 1.