# VR4VR: Towards Vocational Rehabilitation of Individuals with Disabilities in Immersive Virtual Reality Environments

Lal Bozgeyikli*, Evren Bozgeyikli, Matthew Clevenger, Shangdong Gong, Andrew Raij, Redwan Alqasemi, Stephen Sundarrao, Rajiv Dubey

University of South Florida

**Abstract**

In this paper, a virtual reality for vocational rehabilitation (VR4VR) system for individuals with disabilities is presented. VR4VR aims to enable job coaches to use immersive virtual environments to inexpensively and safely assess and train the job skills of individuals with disabilities. Several key system requirements and challenges are discussed, including the need for virtual "distractor" stimuli to observe user behavior in unexpected situations, the need to make the virtual experience and 3D user interfaces adapt to the specific disabilities of the user, and the challenges in maintaining senses of presence and copresence, especially in individuals with cognitive disabilities. In this work, the chosen population includes individuals with autism spectrum disorder, traumatic brain injury and severe mobility impairment. Using virtual reality enables safe immersion of potential employees in a range of scenarios they may encounter, long before they encounter them in a real job.

**Keywords**: Virtual reality simulation, virtual interaction, tangible interaction, navigation through virtual environments, vocational rehabilitation, disabilities, gamification.

**Index Terms**: I.3.7 [Computer Graphics]: Three-Dimensional Graphics and Realism—Virtual Reality

## 1 Introduction

The US Census Bureau [1] reports about 54.4 million Americans have some form of disability. 34.9 million, or 64%, have severe disabilities. From the perspective of "working", any kind of disability that causes an individual to have difficulty finding or maintaining a job is defined to be severe. Another view suggests that if readily available therapeutic techniques can remove the disability problems, it is considered to be non-severe while otherwise it is considered to be severe [2].

Only 17.8% of these individuals were employed in 2012 while this rate was 63.9% for individuals without disabilities [3]. However, over 66% of unemployed individuals with disabilities stated that they would like to be working [4]. Being employed is an important factor in high quality of life since it provides both a sense of self-achievement and economic independence [5, 6]. This work aims to use virtual reality to inexpensively improve access to high quality job assessment and training, and ultimately, help more individuals with severe disabilities gain employment.

The low unemployment rate among individuals with disabilities stems from multiple factors. Some disabilities specifically impair skills needed for a specific job. For example, cognitive disabilities are often associated with decreased concentration and comprehension [7, 8]. Others are associated with difficulty in coping with changes in the environment and deviations from the routine [7]. Another contributing factor is that employers may have prejudice about challenges and disturbances they think employees with disabilities may cause [9, 10]. The two factors mentioned above, prejudice and skill limitations, further contribute to discouragement and a lower sense of self-efficacy and confidence. These factors make some individuals with disabilities reluctant to even seek opportunities to join the workforce resulting in work aversion [11, 12].

Job training plays a crucial role in decreasing the effects of these negative factors. With proper job training, individuals with disabilities can fulfill assigned tasks properly, and employers can realize that their concerns are baseless. However, providing good training for individuals with disabilities requires access to real job sites that employers might be hesitant to provide. Even if an employer provides access to a job site, trainees may still encounter dangers. For example, depending on the nature of the disability, a kitchen environment with sharp knives, hot surfaces and liquids could be inherently risky. As an alternative to on-site training, we propose an innovative virtual reality system for vocational rehabilitation of individuals with disabilities for safe assessment and training.

The aim of the proposed system is to provide an effective vocational rehabilitation service by providing a virtual environment to assess and train individuals with severe disabilities and underserved groups in a safe, adaptable and motivating environment. The system also enables job coaches to determine the most suitable job for them by providing a broad range of tasks in different environments. The system is designed to cater to three types of disabilities: autism spectrum disorder (ASD), traumatic brain injury (TBI) and severe mobility impairment (SMI) such as stroke or spinal cord injury patients. These groups were chosen because of the prevalence of the disability and possible benefits to the group that can be gained from such a system.

The most distinctive novelty of the proposed system is using immersive virtual reality (VR) for job training. This allows for easily changing virtual environments (VEs), which would otherwise be costly and labor intensive. The major advantages of using virtual reality can be listed as: (1) the ease of real time adaptation to the specific needs of the user; (2) the ability to simulate a wide range of scenarios; (3) making it possible to apply significant distractions such as lighting and arguments with coworkers as many times as desired with different intensities, but without causing any physical damage; (4) finding job alternatives that are suitable for the trainee rapidly; (5) automated assessment and training data collection and trainee progress tracking; (6) safety to the trainee; (7) repetitive training; (8) using real time intervening prompt aids that are designed specifically for the user's disability such as pictographs, flowcharts and guiding animations for some cognitive disabilities; (9) a motivating training medium designed with gamification principles to remove the stress of training in a real job environment.

This paper focuses on a detailed description of the VR4VR system today. A preliminary version of our system at its early

* gamze@mail.usf.edu

2014 2nd Workshop on Virtual and Augmented Assistive Technology
30 March, Minneapolis, Minnesota, USA
978-1-4799-4070-7/14/$31.00 ©2014 IEEE

stages can be found in [13]. In addition, [14] discusses the challenges of designing effective training environments for individuals with disabilities for whom previously proven 3D user interfaces (3DUIs) may be ineffective. The rest of this paper is organized as follow. Section 2 discusses related work. Sections 3-5 provide a general system overview followed by more detailed explanations of significant system components such as environments, tasks, job coach's control panel, distractors, assessment and outcomes. Section 6 concludes the paper and offers directions for future work.

## 2 Related Work

Few studies on usage of virtual reality for learning/training and gaming focus on individuals with disabilities. Finkelstein et al's Astrojumper is a virtual reality system to provide children with autism an encouraging way to exercise [15]. Although this work constitutes a good example of designing virtual interactions for individuals with disabilities, the work only focuses on exergaming for children with autism.

Most of the recent studies center upon providing prompts that aid individuals with cognitive disabilities in completing assigned job tasks. Chang et al. proposed a virtual reality system for prompting individuals with cognitive disabilities using Kinect [16]. The study specifically focuses on assisting individuals in food preparation training. Tracking only hand and wrist joints limits the study to tasks that are performed in a fixed location on a table. Some previous works utilized palm size computers for prompting, such as Chang et al's context aware vocational prompting system that uses palmtop computers and Bluetooth beacons [17]. The work constitutes a good example of using emerging technology for real time user specific prompting, but it uses real job environments for user training. Finding these physical areas and creating training scenarios are labor-intensive and time consuming, which is one of the aspects of real life vocational training that we aim to address.

Some works use more conventional methods to provide learning for individuals with disabilities, such as Mechling and Ortega-Hurndon's work in which computer based video instructions are employed for teaching job tasks to individuals with intellectual disabilities [18]. Although this work provides effective learning for individuals with disabilities, more immersive virtual environments involving 3DUIs may be more effective. It will give the user the opportunity to have hands-on experience performing a wide range of different realistic scenarios in a virtual environment.

Apart from these previous works, our system is novel in using immersive 3D virtual interactions for job training that are designed considering specific needs of each group of disability separately. A significant contribution of the proposed system is the use of a Head Mounted Display (HMD) combined with motion tracking to enable realistic immersive scenarios involving both tangible and virtual interaction in different job environments. Another significant contribution is the integration and use of an affordable state of the art robotic technology, Baxter Robot, to enhance object manipulation capabilities of individuals with physical disabilities.

## 3 Technical Aspects of Virtual Reality for Vocational Rehabilitation System

VR4VR system is designed to be adaptable to the varying needs of a range of disability groups. This section describes technical components of our system such as hardware components and implementation.

### 3.1 System Components

**Motion Tracking:** A motion tracker that recognizes movements of the user via retro-reflective markers and surrounding cameras are used for individuals who would not be irritated by wearing bands with markers on their hands. For other individuals, Microsoft Kinect [19] is used to track movements without any physical contact.

**Display:** An HMD that enables the user to see the virtual environment is used for individuals who would not be irritated by having their vision isolated from real world. For other individuals, wearing an HMD may create a sense of being trapped or bothered. In these cases, the display is projected onto a large curved screen.

**Remote Control:** A remote control interface is implemented on a tablet computer and used by the job coach to tailor the simulation to the user in real-time

**Virtual Assistive Robot:** To enable individuals with severe mobility impairments to train for jobs that require mobility and object manipulation, we are integrating assistive virtual robots into the system. These include virtual versions of the Baxter robot [20] and a wheelchair mounted robotic arm [21]. We hypothesize that such virtual robots can be used to train individuals with disabilities to control real-world counterparts, the virtual Baxter robot will help users complete job tasks with complex movements, such as carrying boxes and making a bed, more efficiently. Control of the virtual robot will be customized to the unique needs of the user (e.g., via joysticks, brain-computer interfaces, tongue-based control, etc.). Forward kinematics and inverse kinematics will be integrated into the control system for easier manipulation. The user will be able to observe the interaction between the virtual robot and the environment in real time and will simulate the dynamic characteristics of the physical robot.

To enable tangible virtual interaction, we integrate both fixed physical elements (such as tables), and moveable objects (such as boxes) using infrared markers. A general view of the system with the usage of marker based optical motion tracking and HMD can be seen in Figure 1.

Figure 1: Practicing job tasks in a warehouse environment. The user wears a HMD to see the virtual environment. Motion tracking with infrared markers allows the user to interact with the virtual world using natural movements and physical objects.

There are different advantages and disadvantages of various hardware components which entail a compromise on selecting which one to use. Using Microsoft Kinect for motion tracking has the advantage of touchless interaction. On the other hand, considering its technical capabilities and working principle, Microsoft Kinect is not expected to give as accurate results as an optical marker-based motion tracking system that is composed of several surrounding cameras. A similar compromise occurs between HMD and curved screen. HMD gives more 3D sense and enhances immersion of the user. But curved screen projection may be more appropriate in some users with ASD, for whom the physical contact with an HMD may be distressing. As we consider Baxter and wheelchair mounted robotic arm options, again we see a compromise. For potentially dangerous environments, using Baxter from a distance enables a safer form of interaction with the cost of degradation of 3D sense. Using wheelchair mounted robotic arm on the other hand requires the individual to be physically there as a disadvantage but on the positive side provides physical interactions with better 3D sense.

### 3.2 Implementation

The system is currently under development and several modules are implemented for the usage of individuals with different needs. We describe two modules here, tangible and touchless, each tailored to the unique needs of different populations.

#### 3.2.1 Tangible Module

A module emphasizing realistic tangible interaction is developed. To enhance realism, the virtual world is aligned with the physical world. A picture taken while the user is interacting with the implemented module is presented in Figure 2. The user wears a HMD in which she sees the environment. The view displayed to the user inside the HMD is presented in Figure 3. As it can be observed from the figures, the environment is kept very similar to the one the user sees in the physical world. 3D models that are virtual replicas of the real objects are used to ease the transition of the user from real to virtual world. Boxes that are equipped with markers are used so that the user can carry boxes naturally and see their identical virtual movements. An order filling and delivery placement task that assesses sorting and order following abilities of the user is designed for this module. The implemented module provides realistic interaction but does not cater to individuals with ASD since HMD is used for viewing and physical marker accessories are worn on body for motion tracking.

#### 3.2.2 Touchless Module

Another module with touchless interaction is also developed considering needs of individuals with ASD. This module involves both a third person view that is fixed and a first person view that changes with the head orientation of the user. The third person view is presented in Figure 4 and first person view implementation is presented in Figure 5.

Both views have their own advantages and disadvantages. The first person approach provides a more realistic viewing experience with higher sense of depth since the angle of view changes with the head orientation. But since the curved projection screen is stationary and only partially surrounds the user, as the user turns to look to the right or left side, the view on the screen moves accordingly. The user, in this case, has to unnaturally look at the screen from the side. This causes motion sickness in some users [25]. The third person view, on the other hand, provides a stable viewpoint from a distance which eliminates motion sickness, but it limits the user's sense of depth since the user views the virtual world from a fixed angle. We integrated some guiding mechanisms such as showing hand shadows and changing colors of the objects as the user holds them to overcome this limitation. But more work is still needed to address the challenges of third person views. Individuals with ASD might have difficulty in projecting themselves into imaginary situations [26] and hence may not be comfortable with third person view, so our current work focuses on improving the first person view.


Figure 2: The user interacts with tangible boxes that are equipped with markers while seeing their identical motion in virtual world through HMD.

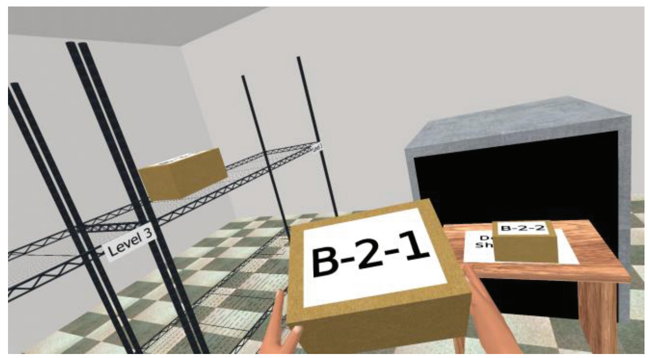


Figure 3: View that the user in Figure 2 sees inside the HMD.

## 4 Design Aspects of Virtual Reality for Vocational Rehabilitation System

Designing the system to be comfortable for all three populations requires special consideration of each one's needs. This section presents design considerations such as feedback tools, gamification, design of virtual environments and tasks under relevant subsections.

### 4.1 Giving Feedback

To provide effective training, virtual visual and auditory aids are designed specifically considering special needs of individuals belonging to different disability groups. For example, showing requested tasks as pictographs of simple drawings and few words helps individuals with autism in understanding, while auditory feedback may be less effective due to limited language processing [22]. Pictographs that show simple drawings of tasks broken down in components with plain explanations of few words are prepared for autism group. Individuals with TBI are known to benefit from information cards that involve simple drawings and brief information that is not necessarily as limited in the number of words used as in autism cases. In addition, flow charts help them understand and assess possible choices [23]. Information cards and flow charts are prepared for individuals with TBI considering these guidelines. Since severe mobility impairment does not involve cognitive impairments [1], auditory information can also be used to give feedback and instructions to this group (in addition to existing visual and written information).


Figure 4: The user interacts with virtual boxes coming through a conveyor belt while seeing third person view that is displayed on a curved screen.

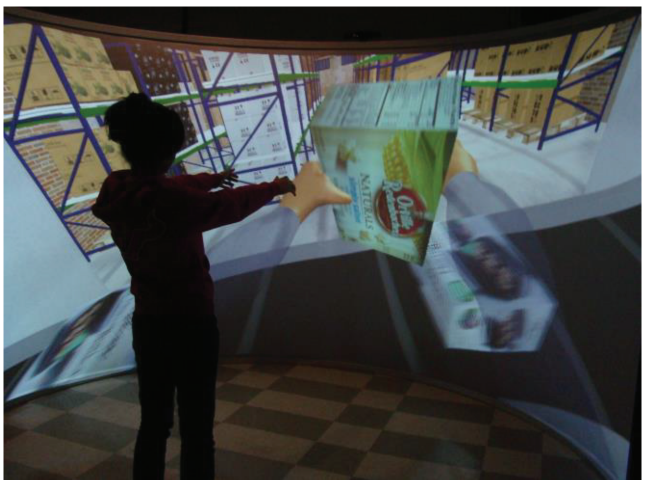

Figure 5: The user sees virtual world from first person view.

### 4.2 Gamification

Gamification is used to motivate and encourage the user, tailoring the system to users' special needs related to their disabilities. Tasks are designed so that the user starts with the easiest one and presented with more advanced ones gradually. While increasing the complexity of the tasks, reinforcement is also used to make the user repeat the already gained knowledge using the saw tooth model which involves providing the user breathing space between difficult challenges by inserting simpler challenges in between [24]. A reward system that emphasizes achievements is also designed to encourage the user to engage with the training system.

### 4.3 Virtual Environments

The designed system involves different virtual environments, including a warehouse, hotel and grocery. In deciding these environments, areas that offer most employment opportunities for individuals with disabilities were taken into account. Another reason for selecting these environments is the wide range of possible job tasks that are associated with them. Warehouse and hotel room virtual environments can be seen in Figure 6. These virtual environments are designed to be as similar to real environments as possible to facilitate transition of the individual from virtual to real environments. Cartoonish modeling and size altering are avoided intentionally.

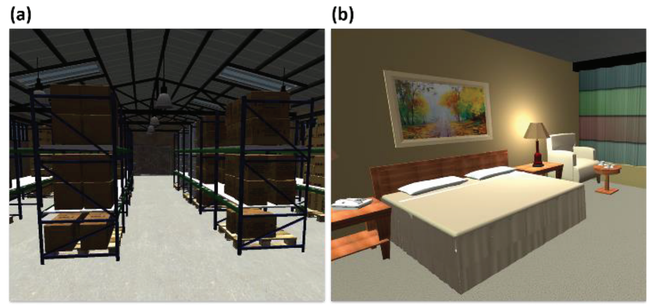


Figure 6: Job environments. (a) Virtual warehouse job site. (b) Virtual hotel room job site.

### 4.4 Tasks

For each environment, there are various tasks that are designed specifically considering the needs of the three disability groups. Tasks are broken down into components and presented to the individuals with explanatory pictographs. While the user is performing these tasks, interactive prompts and feedback are given via visual and auditory aids to assist and reinforce learning.

#### 4.4.1 Warehouse Tasks

For warehouse tasks, inventory organization and order preparation for shipment are stated to be the most important ones [27]. Tasks that involve sorting, order fulfillment and shelve placing are emphasized for individuals with ASD. Tasks of carrying boxes to relevant shelves that require bending and stooping movements are highlighted for individuals with TBI. For individuals with severe mobility impairment, tasks that involve object manipulation and carrying with precision using assistive robots are designed.

#### 4.4.2 Hotel Room Tasks

The hotel environment provides different task design opportunities. For individuals with ASD, tasks that emphasize checklist following, such as checking and supplying missing room amenities, are designed. Tasks that require physical motion, such as hotel room cleaning, changing linens and making beds, are designed for individuals with TBI. Tasks that require precision, such as collecting dirty laundry or trash bags in front of room doors are designed for individuals with severe mobility impairment.

#### 4.4.3 Grocery Store Tasks

Grocery environments involve customer service tasks like cashier but it also involves many shelving tasks that can be considered to be similar to warehouse environment at first glance. The difference is that grocery store has many more possible distractors such as breaking and spilling beverage bottles and presence of customers which may create anxiety. Tasks that include sorting such as placing left over items on shelves are designed for individuals with ASD. For individuals with TBI, tasks that include restocking of shelves with new deliveries and cart collection are designed. Finally, for individuals with physical disabilities, cashier tasks are designed because they do not require locomotion and this population is expected to handle customer interaction intense tasks well, without anxiety and distraction since they do not have any cognitive disabilities.

## 5 Integrating Job Coaches into Virtual Reality for Vocational Rehabilitation System

Job coaches play a crucial role in vocational training of individuals with disabilities since they know about and can help in special needs related to disabilities. Considering this, we emphasize comfortable interaction of job coaches with our system. In this section, the control panel of the job coach and distractors are presented.

### 5.1 Coach's Control Panel

To enable the job coach to manage the training simulation and watch it from various different cameras, a separate control panel is being implemented on a tablet computer. Features of this panel can be listed as: switching to different camera angles to better view and analyze the user's actions; triggering distractors in real time to assess trainee behavior in unexpected circumstances; pre-defined scenario and environment selections; taking and saving notes for future revisiting; activity logs of each user/simulation; and reports involving current and previous scores of the users. Simulation sessions will be recorded digitally so that job coaches can replay and examine the user's assessment and training progress. This helps in both examining movements of the user after the simulated task is completed, and explaining to the user what they have done right or wrong with the aid of a video that may ease their understanding. A preliminary implementation of the job coach's control panel that involves distractions, activity log and timer can be seen in Figure 7.

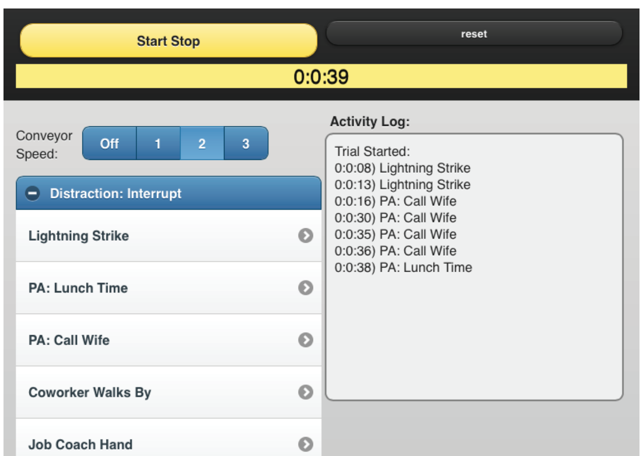


Figure 7: Job coach remote control panel implemented on tablet computer for a task to sort items moving on a conveyor belt.

### 5.2 Distractors

Individuals with cognitive disabilities may have some fears or distractions that degrade their job performance. The proposed system enables job coaches to apply various distractors in real time, which may trigger these fears. If these fears were to be discovered in a real job environment, the outcome could be negative. After they detect which distractors trigger fears, job coaches can help users to overcome them, or can direct them to a job that excludes these types of distractions, if they can't be overcome. Example distractors are: fire alarm, lightning, various intercom announcements, movement of surrounding people/objects, various types of noise, presence of coworkers, flickering fluorescent lights, shiny objects and abrupt machine halting.

## 6 Evaluation

In this section, assessment of individuals using the system and expected outcomes are discussed.

### 6.1 Assessment

To assess job skills of trainees and acceptability of the developed virtual reality environment, several performance measures will be collected, such as accuracy of the performed task, number of prompts given, number of achievements, task completion time, improvement of user performance over time, response to distractors, work tolerance, number of job possibilities, number of job placements and sustainability of the job at which the individual is placed.

### 6.2 Outcomes

Major anticipated outcomes of this project include an effective virtual reality job training system that involves a range of different interaction methods to cater to the three targeted disability groups, and a workforce of 15 individuals (5 from each disability) who are trained with the developed system. We will study another 15 individuals with similar disabilities that go through traditional training approaches, and compare the progress and placement with those that use the developed simulator system. Other expected outcomes of the study can be listed as follows: Identifying distractors that affect trainee performance negatively; identifying ways of using the virtual environment to help trainees overcome these distractions; finding the most suitable job for the trainee based on the conducted assessments; training the individual for the specified job under the detected distractions; and placing the individual at a real job considering training results and observations.

We believe that the proposed virtual reality training system will increase employment opportunities for individuals with disabilities since it provides an innovative alternative to conventional on site job training with several practical advantages.

## 7 Conclusion

In this paper, the design and development of an innovative virtual reality system providing virtual experiences that aid in vocational rehabilitation of individuals with severe disabilities is presented. The proposed system has great potential for wide usage after completion since it is practical, modifiable and cost effective. It may also be expanded to cover training of individuals with other disabilities. As future endeavors, we are exploring ways of tailoring virtual reality interaction most effectively to the needs of different disability groups and possibilities of using Baxter technology to assist individuals with physical disability.

## Acknowledgments

The authors would like to thank the Florida Department of Education for funding this project.

## References

[1] M. W. Brault. Americans with disabilities: 2010. US Census Bureau, Census Brief, 2012. [On-line] Available: http://www.census.gov/prod/2012pubs/p70-131.pdf [Feb. 6, 2014].

[2] W. C. Stolov. Comprehensive Rehabilitation: Evaluation and Treatment. In W. C. Stolov and Clowers M. R. ed. *Handbook of Severe Disability: A Text for Rehabilitation Counselors, Other Vocational Practitioners, and Allied Health Professionals*. U.S. Department of Education, Rehabilitation Services Administration, Washington DC, 1981, 83-100.

[3] Persons with a Disability: Labor Force Characteristics Summary. Internet: http://www.bls.gov/news.release/disabl.nr0.htm, [Feb. 6, 2014].

[4] Empowerment for Americans with Disabilities: Breaking Barriers to Careers and Full Employment. Washington, DC: National Council on Disability, 2007. [On-line] Available: http://www.ncd.gov/publications/2007/Oct2007 [Feb. 6, 2014].

[5] L. Schur. The Difference a Job Makes: The Effects of Employment among People with Disabilities. In *Journal of Economic Issues*, Volume 36, 339–347, 2002.

[6] S. Yasuda, P. Wehman, P. Targett, DX. Cifu, and M. West. Return to work after spinal cord injury: a review of recent research. *NeuroRehabilitation*. 17(3):177–186, 2002.

[7] Teaching Students with Autism Spectrum Disorders. Department of Education, New Nouveau Brunswick, 2005. [On-line] Available: http://www.gnb.ca/0000/publications/ss/teachingstudentswithautismspectrumdisorders.pdf [Feb. 6, 2014].

[8] Understanding Brain Injury: A Guide for Employers. Mayo Clinic, Rochester, Minnesota, 2000. [On-line] Available: http://www.mayo.edu/pmts/mc1200-mc1299/mc1298.pdf [Feb. 6, 2014].

[9] Traumatic Brain Injury (TBI) & Post-Traumatic Stress Disorder (PTSD): Do's and Don'ts for Employers & Hiring Managers. America's Heroes at Work. [On-line] Available: http://www.americasheroesatwork.gov/forEmployers/factsheets/dodonts/ [Feb. 6, 2014].

[10] H. S. Kaye, L. H. Jans, E. C. Jones. Why Don't Employers Hire and Retain Workers with Disabilities? *Journal of Occupational Rehabilitation*. Springer, USA, Volume 21.4, 526-536, 2011.

[11] J. P. Hall and K. Parker. Stuck in a Loop: Individual and System Barriers for Job Seekers with Disabilities. The Career Development Quarterly 58, 246-256, 2010.

[12] P. Loprest and E. Maag. Barriers to and Supports for Work Among Adults with Disabilities: Results from the NHIS-D. The Urban Institute, U.S. Department of Health and Human Services, 2001. [On-line] Available: http://aspe.hhs.gov/daltcp/reports/barriers.htm [Feb. 6, 2014].

[13] C. A. Wingrave, R. M. Alqasemi, M. Clevenger, S. Sundarrao and R. Dubey. Virtual Reality for Vocational Rehabilitation, Training and Assessment. *IEEE VR 2013 Workshop on Virtual and Augmented Assistive Technology (VAAT 2013)*. Orlando, 2013.

[14] E. Bozgeyikli, L. Bozgeyikli, M. Clevenger, A. Raij, R. Alqasemi, S. Sundarrao and R. Dubey. Poster: Design and Development of a Virtual Reality System for Vocational Rehabilitation of Individuals with Disabilities. 3DUI. 2014, to be published.

[15] S. L. Finkelstein, A. Nickel, T. Barnes, and E. A. Suma. Astrojumper: Designing a virtual reality exergame to motivate children with autism to exercise. In *Proceedings of the 2010 IEEE Virtual Reality Conference (VR '10)*. IEEE Computer Society, Washington, DC, USA, 267-268, 2010.

[16] Y. Chang, L. Chou, F. Wang, and S. Chen. A kinect-based vocational task prompting system for individuals with cognitive impairments. *Personal Ubiquitous Comput*. 17, 2 (February 2013), 351-358, 2013.

[17] Y. Chang, W. C. Chang, and T. Wang. Context-aware prompting to transition autonomously through vocational tasks for individuals with cognitive impairments. In *Proceedings of the 11th international ACM SIGACCESS conference on Computers and accessibility (Assets '09)*. ACM, New York, NY, USA, 19-26, 2009.

[18] L. C. Mechling and F. Ortega-Hurndon. Computer-based video instruction to teach young adults with moderate intellectual disabilities to perform multiple step, job tasks in a generalized setting. *Educ Train Develop Disabil.* 42:24–37, 2007.

[19] Microsoft Kinect for Windows. Internet: http://www.microsoft.com/en-us/kinectforwindows/ [Feb. 6, 2014].

[20] Rethink Robotics Baxter Robot. Internet: http://www.rethinkrobotics.com/products/baxter/ [Feb. 6, 2014].

[21] P. Shrock, F. Farelo, R. Alqasemi and R. Dubey. Design, Simulation and Testing of a New Modular Wheelchair Mounted Robotic Arm to Perform Activities of Daily Living. In *Proceedings of the 2009 IEEE 11th International Conference on Rehabilitation Robotics*. Japan, June 23-26, 2009.

[22] Teaching Students with Autism Spectrum Disorders, Department of Education, New Nouveau Brunswick, 2005.

[23] Accommodating Employees with TBI, America's Heroes at Work. Internet: http://www.americasheroesatwork.gov/forEmployers/factsheets/accommodatingTBI/ [Feb. 6, 2014].

[24] E. Adams. Fundamentals of Game Design (2nd ed.). New Riders Publishing, Thousand Oaks, CA, USA, 2009.

[25] H. Shigemasu, T. Morita, N. Matsuzaki, T. Sato, M. Harasawa, and K. Aizawa. Effects of physical display size and amplitude of oscillation on visually induced motion sickness. In *VRST '06: Proceedings of the ACM symposium on Virtual reality software and technology*. ACM Press, New York, NY, USA, 372–375, 2006.

[26] N. Dahl and A. Arici. Employment Planning for People with Autism Spectrum Disorders. *Speaker's Journal*. Volume 8.15, 157-164, 2008.

[27] What Does a Warehouse Worker Do?. Internet: http://www.wisegeek.org/what-does-a-warehouse-worker-do.htm [Feb. 6, 2014].