

Development, evaluation and commercialization of assistive kitchen technology in Canada

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INTRODUCTION

Currently, the standard design of most kitchens limits the usability of many kitchen functions for people with disabilities, limited mobility, and limited agility. New technology is being developed, evaluated and commercialized in Canada to address the need to transform kitchens to full function for persons with disabilities, particularly those with mobility impairments. The authors are developing a variety of height adjustable kitchen components to enable people with mobility impairments to have full functionality of the kitchen.

STATE-OF-THE-ART HEIGHT ADJUSTABLE KITCHEN COMPONENTS

Manufacturers

Automation equipment for building height adjustable kitchen systems is currently available from a limited number of manufacturers world-wide or is custom-made and assembled by robotics and automation volunteer engineers (e.g., TETRA). These height adjustable cabinets and countertops can be controlled either manually or electronically with a range of user controls including hardwired buttons, pendants and remote controls. Other products include height adjustable tables that can be adjusted manually or electrically.

Demonstration Kitchen

Recently Peak Interiors designed and installed a research kitchen in the Blusson Spinal Cord Centre in Vancouver, BC for the International Collaboration on Repair Discoveries (ICORD) [1]. The design incorporated several unique sub-section kitchen areas where different types of research projects can be undertaken, including a standard galley kitchen layout, an area for demonstrating low-tech adaptations and a fully automated galley style kitchen area. The standard galley style kitchen was designed to demonstrate low tech solutions for persons with mobility impairments in wheelchairs, e.g., removal of kick plates and shelving

to allow access underneath standard height counter tops (right side of Figure 1).



Figure 1: Demonstration Kitchen

The fully automated galley style kitchen (left side of Figure 1) consists of a fridge and side opening oven on lifts, three electrically height adjustable countertops, an electrically height adjustable range, and two electrically height adjustable wall cabinets. An electrically height adjustable sink is installed in the central kitchen island as well (See Figure 2).



Figure 2: Height Adjustable Sink

The automated kitchen allows full access to all cabinets, countertops and appliances for a person seated in a wheelchair. One of the major benefits of a fully automated kitchen like this is that it can eliminate the need for full-time care giving related to daily food preparation activities.

During the course of the design and installation of the demonstration kitchen several areas of best practices emerged. The first area involved the coordination with the general contractors and sub-trades. It is critical to have good communication between all members of the project team. Also it is critical to ensure the specifications are met by the contractors as they are critical to the safety of the installation of the equipment, particularly if it is the general contractor's first exposure to automated home equipment. One area of critical importance is the strengthening of the existing wall so that the automation equipment for raising and lowering wall cabinets can be safely coupled to the wall. Several construction options exist and are best determined for each job, for example plywood backing behind drywall can be used (the plywood thickness and fastener type should be calculated for the appropriate safety rating prior to any work undertaken by the general contractor. This should not be left for the general contractor to determine).

Another issue to be aware of is the use of automated equipment in a home environment. It is important to follow all instructions regarding installation of equipment from the manufacturer and to be aware of potential pinch points between movable kitchen components. Users can also choose to include safety stops in the design of their kitchen on both the wall cabinets and on the countertops and tables that prevent them from crushing an object that is blocking them. The wall cabinets can be outfitted with a plate that has sensors in it on the bottom of the cabinet. If a bottle is inadvertently left on the countertop underneath a movable wall cabinet, the wall cabinet will stop when it comes into contact with the bottle (see Figure 3). The countertops and tables can have a tape switch installed underneath the countertop that stops the countertop and/or table when an object causes the tape switch to be activated.

Aesthetics are of great importance in the home environment. In addition to the safety precautions the design of home automation must take into consideration visual design and the noise levels generated by the equipment.

CSA or UL approval or equivalent is also important for these products to ensure they meet the Canadian Electrical Code and local building codes.

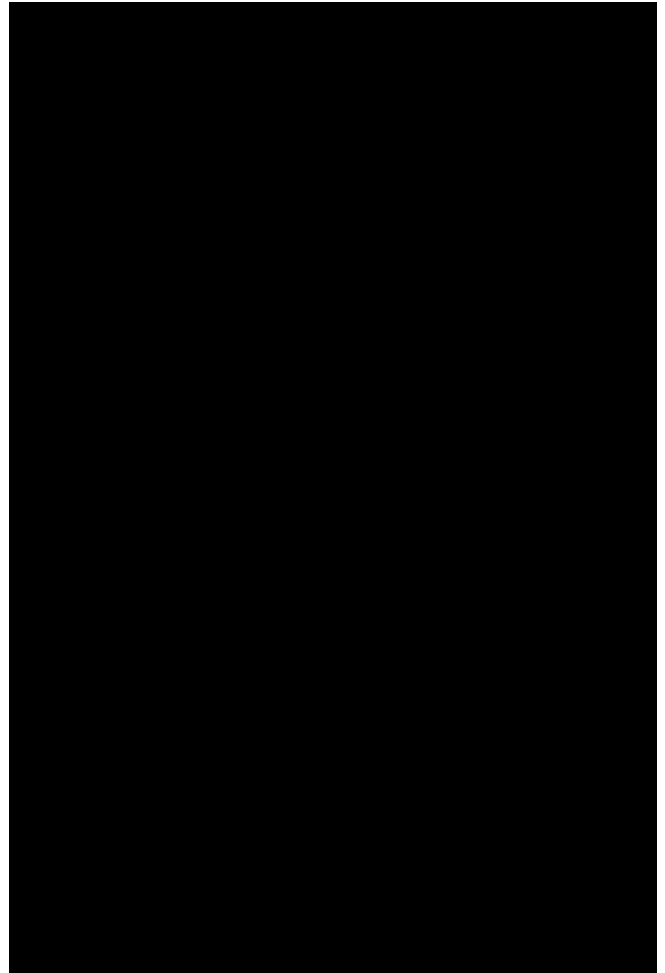


Figure 3: Safety Stop on Wall Cabinet

INFORMAL EVALUATION OF DEMONSTRATION KITCHEN

The demonstration kitchen provides the ability to obtain short-term anecdotal feedback from a range of users groups (e.g., user group tours or occupational therapists in-service training) as well as the ability to design and conduct long-term research projects. Health professionals, disability service groups, housing developers, construction professionals, cabinet manufacturers, design engineers, students, caregivers and end-users have been toured through the completed installation for demonstration and feedback on the equipment.

Although this equipment has been effectively in use in Europe it requires education of users in Canada. This also gives the Canadian users an opportunity to provide feedback for improvement of the

products for use in North America. To date the feedback on the functionality of the demonstration kitchen has been very positive and has generated interest from a variety of end users and occupational therapists. The ability to create a kitchen that can be used comfortably and fully by all users in a multi-user home where one person is in a wheelchair and others are able bodied has been seen as an excellent way to ensure persons with disabilities can participate fully in life. For those individuals that live alone in wheelchairs the ability to have caregivers, family and friends visit and readjust the kitchen components to heights they are comfortable with was also seen to be a positive. Some areas that could be improved have been noted in the user interfaces and the speed of the wall cabinets.

DESIGN PROBLEMS

The need for other types of height adjustable kitchen components not currently on the market has been identified by the user groups described above. Areas that have been identified for new product design include:

- Options for installing height adjustable equipment that do not require specialized construction techniques or major general contracting.
- Increasing the maximum weight load the automation equipment can lift, so more items can be placed into the table such as a sink, range, and cabinetry, e.g., a wine rack (Current weight restriction does limit the number of features the table can support),
- Improving the design of user interface (e.g., buttons or remote controls), and
- Adding advanced control options, e.g., developing iPhone or other bluetooth control applications.

DESIGN SOLUTIONS

Initial focus is on the development of a height adjustable kitchen island system to reduce the complexity of the renovations to existing kitchens thereby reducing the cost. The authors' product development philosophy is anchored in a user-centered model for assistive technology. The BC Coalition for People with Disabilities has developed a model for doing this called the Participation Model for Personal Supports [2]. Involving end users early in the product development stages of the system is planned for at the ICORD demonstration kitchen.

The kitchen island system is currently in the definition of design requirements and conceptual design phase. A number of key requirements include:

- Must be able to be installed without a general contractor.
- Must be able to lift a working load of 800 lbs.
- Must be able to incorporate a number of appliances to meet user needs.
- Must be able to accommodate a wide variety of kitchen décor.
- Must meet requirement for CSA and UL approval.

BCIT students from the Mechanical Design Option of the Mechanical Engineering Technology program are currently working on new designs for the drive mechanism to reduce cost while maintaining the requirements for loading. Authors are also sourcing automation and framing components for the initial prototype. Local cabinet manufacturers are also being involved to provide a cost effective system of cabinets, shelving, countertops, and other necessary trim components to complete the initial prototype.

CONCLUSION

New cost effective solutions are required to enable people with disabilities to remain fully active in the home environment. The use of height adjustable kitchen cabinets, countertops, appliances, sinks and table tops are a potential solution for people with mobility impairments to stay fully functional in the kitchen. Such technology exists and has been in use in Europe for many years however the Canadian market needs to be educated about the availability of the technology. Solutions to reducing the cost of kitchen renovations are needed. A height adjustable kitchen island system is currently being developed and evaluated by the authors as a way of reducing the cost of adapting the kitchen while maintaining the functionality provided by height adjustability.

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REFERENCES

- [1] <http://www.icord.org>
- [2] <http://www.bccpd.bc.ca/docs/partmodelemailblack.pdf>