

Accessible Housing by Design—Home Automation

UNIVERSAL DESIGN

People who inhabit and visit the houses and homes we live in come in all shapes and sizes. They range in age from infancy to old age with a variety of ever-changing abilities and skills. Housing needs change for all of us as we grow-up, grow old and welcome new people to our homes. A home that is designed and built to reflect the principles of universal design is safer and more accommodating to everyone who inhabits or visits it, no matter what their age or physical ability.

The philosophy of universal design is that your home should be comfortable, pleasant, safe and usable by everyone in your family, be it your children, you or your spouse, aging parents or a relative with a disability. The use of technology and automation can help create

living spaces that are convenient and energy efficient, minimize the potential for accidents and result in a house that is able to adapt to life's changes—whether caused by changing family composition or the changing abilities of family members.

USING TECHNOLOGY IN THE HOME

Devices originally designed for people with disabilities are found in every home. The remote control was originally developed to help people with limited mobility control their environment. Today remote controls are used by everyone.

Home automation now being developed for the general consumer market provides even greater benefits to people with physical, sensory and mental disabilities, allowing them to live more independently.

An overview of the key concepts of universal design is provided in “The Principles of Universal Design” text box on page 11.

Bolded terms throughout this fact sheet are defined in the “Glossary” text box on page 10.

WHAT IS HOME AUTOMATION?

Home automation systems, or smart home technologies, are systems and devices that can control elements of your home environment—lighting, appliances, telephones, as well as home security, mechanical, entry and safety systems. They can be used to improve safety, expand usability and make life easier for people of all abilities.

Home automation systems can be operated by electricity or a computer chip using a range of different types of switches. A simple device, such as a light, can be activated by a signal from a **motion sensor**, or can be lit as part of a computerized home automation system.

What can home automation do?

Home automation can:

- Increase your independence and give you greater control of your home environment
- Make it easier to communicate with your family
- Save you time and effort
- Improve your personal safety
- Reduce your heating and cooling costs
- Increase your home's energy efficiency
- Alert you audibly and visually to emergency situations
- Allow you to monitor your home while you are away.

Primary elements of a home automation system

The three primary elements of a home automation system are:

1. The operating system (for example, a computer, security system or telephone)
2. The device being operated (for example, a light or a furnace)
3. The **interface**, or link, between the user and the device. An interface can be a button, a keypad, a motion sensor and so on. For example, a thermostat equipped with a computer chip can be controlled by an interface such as a push button, which sends a signal to the furnace to adjust the temperature for different times of the day and night.

The Appendix on page 8 lists other examples of interfaces. Also listed in the Appendix are assistive technologies. These technologies are controls that have been specifically developed to give people with disabilities greater control of their environment.

DEVICES AUTOMATION CAN CONTROL

Automation can handle many simple and repetitive tasks, such as having lights come on at dusk or closing the curtains at bedtime. These tasks can be triggered by a pre-determined **event**, such as a time of day, or by a pre-programmed **scene**, which groups a series of tasks under a single command.

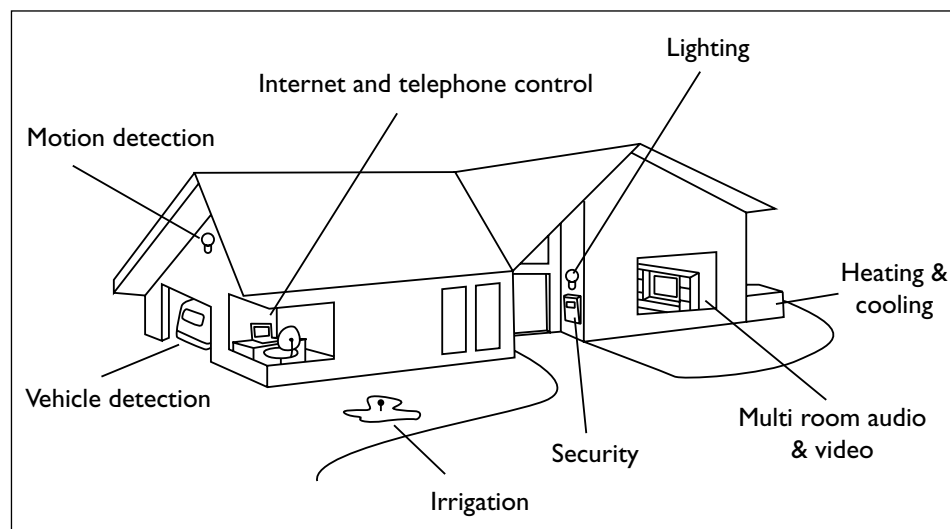


Figure 1 Automating the whole home

Task automation can make everyone's life easier, particularly the lives of people with disabilities or limited agility.

Lighting

Lights on your front porch can automatically turn on when the door is opened to illuminate your path as you go outside, a benefit to everyone but especially people with limited vision. Motion sensors that activate lights can be especially beneficial to people with limited mobility and physical disabilities because they do not have to manually activate a switch.

You can even control and adjust the speed at which lights brighten as you enter a room by using a programmable dimmer switch equipped with motion sensors. This is of special importance to people with visual impairments and older people whose eyes take longer to adjust to changes in illumination. It is also a great safety feature as it eliminates the need to enter a darkened room.

Computer systems can be programmed to operate your entire home lighting system, creating different lighting zones within a room or a selection of alternate **ambient lighting** scenarios.

Television and home entertainment

Home automation enables people to control devices such as the TV, satellite dish and stereo from wherever they are, by simply using a remote control.

Security

Home security systems that charge a monthly fee have been available for many years through security companies that monitor your home. Home computer-based security systems that will notify you directly of any problems at your home are also available. This type of system needs to be set up by a professional, but it is very cost effective as there is no monitoring fee.

A security system offers many options and enables you to control as many or as few devices as you desire. A signal can be sent to the police or a security company if a window has been broken. A security system can even be set to turn off all the lights, lock the doors and turn down the thermostat when you go to bed.

If there is something wrong or unusual at your home, the security system can send a message to notify you that a pipe is leaking or someone has opened your front door, for example.

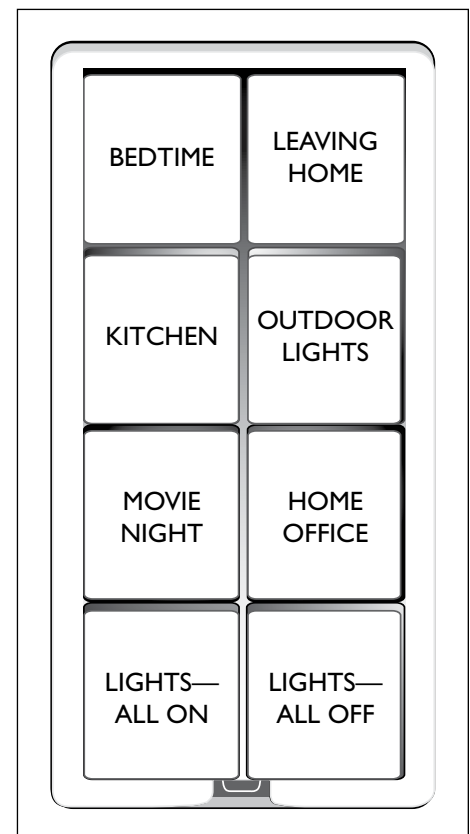


Figure 2 Keypad for programmed scenes

If you use attendant services or are expecting a repair person, you can use your telephone to disarm your security system, unlock the door and let people in.

These systems can also be used to give your home a more lived-in look by randomly turning lights and devices such as TVs and stereos on and off.

Home automation can provide you with greater control of your environment and increase your independence. In addition, cost savings and greater energy efficiency can result.

Heating and cooling

The heating and cooling system is one of the costliest aspects of operating a home.

Programmable thermostats that use computer chips allow the heating and cooling system to be set to run only when needed. This reduces energy consumption and costs. You can program the thermostat to turn on in the morning just before you get out of bed, turn down when you leave for work and turn up again just before you come home. See CMHC's *About Your House* fact sheet *Setback Thermostats* for more information.

With programmable thermostats in different rooms of your house, you can create different zones that can be heated or cooled when occupied.

Some technologies even allow you to call your home computer system, check the temperature and change the thermostat using the telephone keypad.

Some cooling systems can be programmed to turn off the air-conditioning system when an open window is detected and turn the system back on when all the windows are closed.

Telephones

The telephone can be more than a way of communicating with the outside world. A telephone can be used to communicate with someone at the front door and it can even be programmed to release the lock and allow a visitor to enter. This is especially helpful to people who have caregivers or attendants coming to their house. Being able to communicate with and identify the person who is at the door from anywhere in the home is a great feature for everyone, especially for people with visual impairments who may not be able to visually identify who is at the door.

Some telephones can be programmed to ring a unique tone when the doorbell or intercom button is pressed. If you are on the telephone, a unique call-waiting tone will chime.

A programmable telephone is invaluable because it can store the phone numbers of people you frequently call, as well as emergency telephone numbers. This is especially important for people with disabilities who find it difficult to dial the telephone quickly and accurately. Some programmable telephones even respond to voice commands. Wireless headsets provide even greater versatility.

Telephones can be programmed not to ring during specified times of the day, a benefit to parents of small children who nap or seniors who want quiet time in the afternoon or late evening.

People who are hard of hearing are used to telephones that come with both audible and visual notification systems. TDD/TTY (Telecommunications Device for the Deaf/TeleTYpewriter) and computers can be used by people who are deaf or hard of hearing to transmit tones that are displayed as text, facilitating written communication. A TTY can be programmed to automatically answer and take a message.

AUTOMATED FIXTURES AND FITTINGS

Appliances

Computer chips are frequently installed in appliances, such as washing machines, coffee makers and water heaters. They can be programmed to operate when you want or in off-peak energy periods.

Doors

Many people use a remote control to open their garage door. An additional feature is a garage door sensor that will alert you (audibly and visually) if the door is left open.

Opening the front door while carrying a load of groceries is difficult for everyone, but can be especially awkward for people with mobility impairments or with service animals. An automatic lock release and door opener can be activated by a remote control device, similar to the device used to open garage doors.

Windows

What would you do if you were at the store when a sudden thunderstorm started and you had left your windows open?

What if you had a disability and limited strength and could not close the windows yourself? Windows can be closed remotely by your home automation system and they can even be programmed to open automatically when the thermostat registers a certain temperature.

If your security system is equipped with window sensors and a window is opened when it should not be or if a window breaks, the sensor will cause the security system to automatically send you a signal or a pre-recorded message.

Blinds and curtains

For some people, opening and closing the curtains and blinds is more than an inconvenience, it is an impossibility. Many new models of curtains and blinds come pre-automated. However, it may be just as easy to modify existing installations to be able to control them using a remote control or a timer.

Water

Automated faucets are commonplace in public spaces such as washrooms. This technology is now making its way into private homes.

Getting the temperature just right for your morning shower can now be as simple as pressing a button. Electronic shower controls allow everyone in the family to personalize the water temperature and water flow. This not only saves energy—it reduces the danger of burns, which can be a concern for families with young children and people who cannot feel water temperature because of paralysis or a lack of sensation.

Some models provide audible feedback of the selection, a feature useful to people with a visual impairment.

For people who transfer onto a shower bench from a wheelchair or who require assistance entering the shower, models are available that will pause the water flow to allow the user to enter the shower area without getting sprayed.

Large hot water tanks that continuously heat and reheat water until it is needed are no longer necessary, as high-efficiency heaters produce hot water on demand, allowing a continuous flow of hot water for as long as you need it.

Fire and other safety emergencies

Nobody likes to take chances with the safety and lives of loved ones, so it is important to be able to both detect an emergency situation and get assistance when it is needed. This is important since more people with disabilities and seniors are living alone than ever before.

Automated homes can be equipped with alarms that are wired to work with several devices throughout the home. When triggered, smoke and fire alarms can activate telephones that automatically call a pre-programmed number for assistance, can turn the lights in the home on to help people find their way out and ceiling fans off to slow the spread of a fire. At the same time, the security system can be deactivated, so emergency personnel can easily get into the house.

Personal monitoring systems are used by many people as they get older, especially if they live alone. By pressing a button on a wireless pendant or bracelet, the user summons help. Monitoring companies provide the equipment and

monitoring service for a monthly fee. You can select a neighbour or family member to be contacted for assistance. These services are available from most telephone companies across Canada.

If you have someone in your home, such as a senior, child or person with a developmental disability who is prone to wandering away from home, a monitoring system could also help ensure their safety and provide you with peace of mind. A magnetic door sensor can detect if a door has been opened. Another option is a wireless pendant or wrist band that sends a continuous signal to a receiver within the home. When the person attempts to leave the area, the receiver will detect the missing signal and will sound an alarm or dial a pre-programmed number.

There are additional safety devices that can be of great help to people with developmental delays or seniors with Alzheimer's Disease. Door alarms with magnetic contacts will register when a door is opened. For example, if a door is opened in the middle of the night, they can announce the time and relay a message such as "please return to bed."

OTHER CONSIDERATIONS

Individual assessment to get the right technologies

To ensure that you get a system that meets your needs for today and tomorrow, contact a reputable home automation company that can provide you with information. This is especially important for people with disabilities who wish to live independently to the greatest extent possible.

Ask yourself the following questions to see if a home automation system meets your needs:

- Does it have an appropriate interface, switch or control that can be easily used by you and your family?
- Is it simple and intuitive to use?
- Is there enough power to run it?
- Is there a minimal time delay between control operation and feedback?
- Is there some forgiveness for error?
- Will it save time, money or energy?
- Does the system reset to default settings?

New construction and retrofit

A home automation system can be part of a new home design and construction or placed in an existing home without extensive re-wiring. Some devices can simply be plugged into existing electrical outlets.

If you purchase devices and systems that simply plug into existing electrical outlets, you can install them yourself.

However, for more complex network installations and for integration of multiple hardwired devices, it is best to have the systems installed by an electrician.

If you are going to hire a contractor or a professional home automation service provider to carry out improvements, it is advisable to obtain more than one estimate and a list of references. See CMHC's *About Your House* fact sheet *Hiring a Contractor* for additional information.

System requirements

Check the electrical requirements before buying a device or a system. Some systems can use existing home wiring; others

will require wiring upgrades and grounding. It is best to consult an electrician.

Location of control centres

Plan the location of your computers, touch screen controls and telephones so you have easy access and full control over all of your devices.

Compatibility

There are various brands and types of home automation available, some of which will work together, and others that operate only with devices from the same company or brand. When choosing systems and devices, it is important to consider compatibility and future expansion.

Portability

Devices that are not hardwired, such as those that plug into an electrical outlet, are portable and allow for greater flexibility in the event of changes to the home automation features or if you move to another home.

Dedicated computer system

Complex automated home systems require a separate, dedicated computer system. In many cases, these computers

can be configured to work with your regular home computer for added convenience.

Safety backup system

If you are relying on a computerized home automation system to control your alarm system, your garage door and your locks, you should invest in an alternate power source, such as a battery or a generator. See *About Your House: Backup Power for Your Home* for more information.

Energy efficiency

Home automation can save energy by turning off appliances when they are not needed or by programming appliances so that two do not operate simultaneously.

Cost

Devices can be simple and inexpensive or sophisticated and expensive.

Running structured wiring in an existing home may cost \$1,000 to \$3,000, compared to \$600 to \$2,000 for new homes, not including the cost of a central controller.

Wireless systems are less expensive and on average cost between \$100 and \$150 for each connected device and device

controller. There are additional costs for the central controller as well as programming and set-up if you use a professional service provider.

Most basic home automation systems on the market cost approximately \$3,500. Part of the cost of a basic system can be offset by energy savings, but the payback period is lengthy.

Controller features

A device that provides information in several different formats (text, audio, tactile) is more universally accessible to everyone.

APPENDIX

Interfaces

Interfaces are links between the user and the automated device. The following types of interfaces are available on the market today:

Audible sensors—Strategically located microphones that can be programmed to “listen” for sounds such as breaking glass and other loud noises.

Biometrics—Biometrics uses physical identification marks such as fingerprints to control devices such as door locks.

Buttons and keypads—Alphanumeric keypads and push buttons are commonly used as input methods.

Magnetic door and window sensors—Magnetic contacts are applied to doors, windows, garage doors and any hinged component. If the two sides of the magnetic contact separate, a signal is transmitted.

Movement—Motion sensors send a signal to a device when they sense movement.

Pressure (air or weight)—Pressure mats register changes in pressure (like the mats at the automatic doors of grocery stores) and activate a pre-programmed control.

Switches and controls—Rocker and touch switches are the simplest form of control and can be used to activate a multitude of devices.

Voice recognition—The interface recognizes voice commands to activate devices.

Operating systems

Computers, wireless PDAs (for example, BlackBerry, Palm Pilot)—These systems can be programmed to control devices.

Remote controls—Remote controls that use infrared or FM signals are programmed to wirelessly control appliances and devices.

Assistive technologies

The following technologies have been specifically developed to assist people with disabilities.

Foot switch—A foot switch is activated by pressing with the foot on the top of a hinged surface. Foot switches are available in wired or wireless models and some provide tactile and auditory feedback.

Head mouse—A head mouse replaces a standard computer mouse for people unable to use their hands. Using wireless technology, an infrared light is used to track a small target placed on the user’s forehead or glasses and measures the user’s head movements.

Head switch or pillow—This switch is activated with very light pressure from the head and can control devices such as lights.

Joystick—A joystick can be used to activate various devices depending on which direction the joystick switch is moved.

Pinch switch—This switch can be operated with two fingers using very light pressure or it can be surface mounted for one finger operation.

Sip/puff switch—Sipping on a sip/puff tube will operate one device, while puffing will operate a second device.

Touch pad switch/jelly bean—This is a single large button, activated by pressing anywhere on the top surface.

ADDITIONAL RESOURCES

Books

Gill, J. M. (1995). *The Design of Man-Machine Interfaces for Use by Visually Disabled People*. Tokyo, Japan: Proceedings of the International Technical Aids Seminar for the Visually Disabled. Retrieved August 12, 2009, from <http://www.tiresias.org/research/reports/japan.htm>

Gill, J. M. (2001). *Requirements for the Interconnection of Assistive Technology Devices and Information and Communication Technology Systems*. Retrieved August 12, 2009, from <http://www.tiresias.org/research/reports/inter.htm>

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Giroux, S. and Pigot, H. (2005). *From Smart Homes to Smart Care: ICOST 2005*. Amsterdam, The Netherlands: IOS Press.

Mann, W. C. (2005). *Smart Technology for Aging, Disability and Independence: The State of the Science*. Hoboken, NJ: John Wiley & Sons.

Mokhtari, M. (2003). *Independent Living for Persons With Disabilities and Elderly People: ICOST 2003*. Amsterdam, The Netherlands: IOS Press.

Shipley, T. and Gill, J. M. (2005). *Equal Measures: Closing the Accessibility Gap*. Brussels, Belgium: COST. Retrieved August 12, 2009, from http://www.tiresias.org/cost219ter/equal_measures/equal_measures.pdf

Websites

RNIB Digital Accessibility Team (DAT)—Tiresias (March 2010) www.tiresias.org

Glossary

Ambient lighting: The overall illumination of an environment using lamps, overhead light fixtures, sunlight and any previously existing light.

Event: A pre-determined occurrence, such as time of day, decrease in light level, change in noise level, and so on.

Interface: The link, between the user and the device, it is how the user communicates with the system. An interface can be a button, a keypad, a motion sensor and so on.

Motion sensor: A device that uses infrared signals to detect movements in a room or area.

Scene: A scene is a group of actions that are all performed in response to a single command. For example, a “Goodnight” scene can be executed from one button that causes all of the lights to turn off, the security system to arm, and the TV to turn off.

The Principles of Universal Design

Universal design is defined as:

“The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.”

The concept is an evolving design philosophy.

Principle 1: Equitable use

This principle focuses on providing equitable access for everyone in an integrated and dignified manner. It implies that the design is appealing to everyone and provides an equal level of safety for all users.

Principle 2: Flexibility in use

This principle implies that the design of the house or product has been developed considering a wide range of individual preferences and abilities throughout the life cycle of the occupants.

Principle 3: Simple and intuitive

The layout and design of the home and devices should be easy to understand, regardless of the user's experience or cognitive ability. This principle requires that design elements be simple and work intuitively.

Principle 4: Perceptible information

The provision of information using a combination of different modes, whether using visual, audible or tactile methods, will ensure that everyone is able to use the elements of the home safely and effectively. Principle 4 encourages the provision of information through all of our senses—sight, hearing and touch—when interacting with our home environment.

Principle 5: Tolerance for error

This principle incorporates a tolerance for error, minimizing the potential for unintended results. This implies design considerations that include fail-safe features and gives thought to how all users may use the space or product safely.

Principle 6: Low physical effort

This principle deals with limiting the strength, stamina and dexterity required to access spaces or use controls and products.

Principle 7: Size and space for approach and use

This principle focuses on the amount of room needed to access space, equipment and controls. This includes designing for the appropriate size and space so that all family members and visitors can safely reach, see and operate all elements of the home.

About Your House

Accessible Housing by Design—Home Automation

To find more About Your House fact sheets plus a wide variety of information products, visit our website at www.cmhc.ca. You can also reach us by telephone at 1-800-668-2642 or by fax at 1-800-245-9274.

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<i>Measuring the Effort Needed to Climb Access Ramps in a Manual Wheelchair</i>	Order No. 63916

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