Home automation

In the home, appliances and equipment can be controlled automatically and remotely. Automated controls can turn equipment on or off, or adjust operating settings at predetermined times; they can be triggered on site or remotely; they can adjust equipment operation in response to changes, such as temperature, in the home environment. Homes using these techniques, which may also integrate broadband communications, are sometimes called smart homes or smart houses.

Home automation can either be centralised and programmable, or consist of decentralised and isolated sensors and controls. Systems range from sophisticated electronic programmable controls for lighting, heating, cooling and entertainment devices using special wiring or wireless, to just a few isolated, automated systems, such as motion sensors to control lights.

Home automation systems can improve the energy efficiency of your home only if they are designed for this purpose.

Automated systems use energy, so they produce energy savings only if they save more energy than they use. They are typically expensive, so take a significant time to ‘pay back’ the savings from reduced energy costs.

Make designing an energy efficient home, and installing high energy efficient appliances and lighting, your first priority. Then, design home automation systems to reduce the time that energy-using equipment operates or the need for operating equipment (see ‘Automation equipment, sensors and controls’ below).

Automated systems use an electrical signal to switch equipment — usually a light, a motor or heating/cooling appliance — on or off. Lights can be turned on or off on demand or based on timers or sensors. Motors can open and shut blinds, windows and vents; they operate fans, dampers, valves and pumps. Valves and dampers can allow water or air to flow under the influence of the fans and pumps. Motors and heating/cooling appliances can be triggered by timers, sensors or thermostats. Relays are more sophisticated switches that can activate any electrical or electronic device. Computers or specific controllers can automate all of these devices.

Home automation energy management strategies

Heating and cooling control

A well-designed automation system can:

- improve passive solar heating and passive cooling through the control of blinds, awnings, windows, vents and fans
- control heaters and air conditioners so they are used only when and where they are needed and to achieve a desired temperature.

Before considering automation options, ensure that your home is designed to make the best use of solar energy and natural ventilation for passive heating and cooling. (see Passive solar heating; Passive cooling)
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Use thermostats or temperature sensors in different rooms to control heating and cooling. Appropriately placed, they, along with timers to control heating/cooling appliances, can significantly reduce energy use, even if automated systems are not used.

Analyse your heating/cooling needs and how to manage them. Ask yourself: which rooms need to be heated/cooled, when and to what temperature? Aim to heat/cool living areas when people are home but heat/cool bedrooms only at night and in the early morning when they are occupied. Bedrooms do not need to be made as warm or as cool as living areas to be comfortable for sleeping. Don’t heat or cool areas such as halls and laundries, and use the appropriate heating systems for the purposes, e.g. radiant heaters in vented areas. (see Design for climate)

Plan your automation system. Consider how opening and closing blinds, awnings, windows and vents can assist passive heating, cooling and natural lighting. Explore how switching fans and heat shifters on and off might reduce the need for cooling or heating.

Well thought-out and planned temperature profiles can minimise the energy used in heaters and air conditioners/coolers. Consider how the temperature of the house changes, and over what time period, before it reaches the final temperature. Also consider just when heating or cooling is needed.

A temperature sensor is the size of a light switch.
Hot water control

Automate the hot water system so it can be switched on and off as required, e.g. off when going on holidays, on again just before your return. Solar systems can be controlled so they do not require the use of an auxiliary booster during summer months — and the controller overridden during periods of poor solar gain in summer or when demand increases, e.g. family home for Christmas. Be aware that *Legionella* bacteria can grow in water temperatures above 30°C. (see *Hot water service*)

Lighting control

Automate lights through motion sensors and timers, or more elaborate centralised systems, so they operate only when needed and switch themselves off when rooms are vacant.

Use motion sensors to switch on external lights when needed, or lights when entering the home, rather than leaving lights on.

*Use motion sensors to switch on external lights rather than leaving lights on.*

Use motion sensors, light sensors and timing controls to switch off room lights when they are no longer needed, e.g. after five minutes if no motion is detected. Give priority to rooms that often have lights left on unnecessarily, like bathrooms, pantries and toilets. However, take care — five minutes of inaction in front of a TV is not unusual and you may not want all the lights to go off then!
Energy

Appliances and equipment control

Use controls to operate appliances and equipment only when they are needed.

Remote control and timer control of appliances, from coffee makers to home theatres to spas, can save energy if the appliances can be switched off when not required. But take care not to turn on appliances automatically or at preset times — more energy may be consumed if there is no need for the appliance to operate.

Automating equipment control to reduce operating times is particularly useful if the appliances normally use stand-by power when they are not operating, e.g. stereos, TVs, DVDs and home office equipment. It is also useful when the need for the equipment to operate varies, such as for pool pumps, where daily operating hours can be matched to the season.

Stand-by power controllers (see *Home entertainment and home office equipment*) are smart power boards that automatically turn equipment off when not being used.

Energy monitoring

The home automation system can monitor the total energy use of the house or even individual circuits or appliances. Current is measured by a measuring device (which can be fairly low cost) at the meter board, and is converted into power and energy consumption. This information is transmitted wirelessly to an inside display unit or directly to the automation controller. Depending on the system installed, the user can view power, energy, costs and estimated greenhouse gas emissions associated with the whole house. The system can be configured to measure the renewable energy generated by a photovoltaic system or wind generator, and show how much electricity has been exported to the grid. Users can also view this information in real time, or view the past week’s or month’s use. The display can also show environmental or other measurements, such as outside/inside temperature, and hot water temperature. Simple energy monitoring systems are very similar to in-home displays. (see *Smart meters, in-home displays and smart appliances*)

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Automation equipment, sensors and controls

Home automation systems work by managing the electric power of the equipment being automatically controlled. The degree of ‘intelligence’ and how it is distributed between the elements of the home automation system varies with the design and manufacturer.

Control can be implemented by isolated sensors, timers and processors embedded in the switches and relays. Centralised control can be obtained through networked sensors linked to a controller or computer which then operates the power systems of equipment throughout the house.

The operation of more sophisticated equipment such as central heaters, air conditioners or home theatres can also be brought under the control of the automation system, but with more intelligent controlled devices. Take care to ensure the controller’s instructions do not create conflicts, e.g. heating areas that are cooled by the air conditioner.
Automation equipment potentially includes any appliance or machinery in the home whose operation is controlled through its electricity supply, for example:

- hot water system
- appliances
- home entertainment, home office and other electronic equipment
- lighting
- heating and cooling/air conditioning systems
- fans and air pumps/heat shifters
- powered window blinds, shutters and awnings
- powered vents and window openings
- water pumps, pool pumps and spas
- garage doors
- security systems.

Motion sensors, light sensors and temperature sensors can be integrated into the automation system.

The home and its lighting, appliances and systems can be controlled by:

- on-site controllers, which may be special proprietary devices, often activated by touchscreens, or tablets/computers
- remote controllers, allowing equipment to be controlled outside the home or at a distance in the home often by smart phones or tablets
- sensors that operate home equipment in response to changes in the home environment, such as the presence of occupants or changes in external temperature.

Automation systems and design

A wide variety of automation systems is available and most require a professional to design and install. Complete packages from manufacturers offer the hardware and software for central and remote control. Some suppliers promote a more do-it-yourself experience using wireless communications to connect the controllers and sensors, but almost all systems require a registered electrical contractor to install the equipment. Wireless systems are more suited for installation in existing houses, as they do not require a control wire to be used for each switch or sensor. Some systems use the power cabling to send the control signals.

The energy consumption of home automation systems adds to a home’s stand-by power load. In wired systems, the sensors, switches and measurement units are often powered centrally. These systems have only one or two power supplies providing power to all the units in the system; a non-wired system has a separate power supply for each unit. However, the power consumption of wireless systems can also be very low, depending on the manufacturer. Your installer or supplier should be able to calculate overall power consumption of the automation system, which is typically in the range of 20–100W.

*Check the energy consumption of home automation systems before you buy.*

Many other stand-by power loads in a home automation system may not seem obvious, including the power use by the audio equipment or security systems.

Examples of wired and wireless systems.
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Their stand-by power loads can be substantial, e.g. a multi-room audio amplifier may consume 50–100W alone. Carefully consider the design of the system and the components to minimise power use.

Automation and electricity demand

In the near future, home automation systems may be linked to the electricity utility in a number of ways. The utility may communicate variations in electricity prices to a ‘smart’ electricity meter, which interfaces with the home automation controller. (see Smart meters, in-home displays and smart appliances)

Householders can then program appliances to reduce power, save energy or switch off altogether during high price periods.

Alternatively householders could enter a supply contract that allows the electricity supplier to send a signal to equipment controlled by the home automation system (such as air conditioners) to turn off certain equipment for short periods.

The householder may choose to participate and obtain lower electricity prices or other financial incentives as a trade-off for allowing the electricity supplier to have this control.

References and additional reading


Authors

Principal authors: Paul Ryan, Murray Pavia
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