Modern home lighting systems

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Options for automated lighting systems in single rooms

A complete retrofit of an existing home to incorporate **smart technologies** for **energy management** and **home automation** can sometimes be overwhelming to homeowners, both in terms of cost and complexity. Because the energy and time savings from utilizing such systems can be significant, it is worth looking at lower cost solutions.

One option is to use **single room automation**. Unlike systems that are installed throughout a home using structured wiring and data cables, **single room systems** can often be installed into existing homes without tearing out walls to run additional wiring. While they are sometimes limited in functionality, many of these systems can be expanded later.

An example of an effective single room automation solution is **lighting control**. Many lighting control systems offer automatic timing devices to adjust lighting based on user settings. Some of the more modern systems, however, are more automated and use sensor inputs to control lighting in a single room.

Room lighting comes in two forms – natural light and artificial light. Natural light "harvesting" is a term used to describe the use of daylight to augment artificial room lighting during daytime hours. Some companies, like Lutron, now make small systems that combine dimmer switches with automatic window shades. Other companies, like HAI, make systems that are modular and can start in one room and expand to additional rooms.

These systems can be combined with sensor technologies to increase flexibility. Daylight sensors can be used to determine light levels and automatically lower the level of artificial lighting in the room by adjusting the dimmer switchers. This system also works with a motion sensor to determine the presence or absence of people in the room, and can raise or lower light levels accordingly. The new **dimmer switches** are compatible with dimmable LED or fluorescent lighting.

Single room solutions make sense in a number of cases: for small, open concept homes where one large central area is the location of the majority of activity in the home; classrooms, studios, or exhibit rooms with high levels of natural light; and, larger, older homes that may be inherently energy inefficient, but are difficult to automate with a whole-house system. The bottom line is that with new products on the market, there is a solution that can increase energy efficiency in lighting in a convenient, automated way, even for those on a tight budget.

Are Distributed OLED Light Sources Poised to Change Home Lighting?

Since before the invention of the incandescent light bulb, lighting in the home has been accomplished by the use of **point light sources**. As candlelight and gas lamps transitioned to electrical lighting, room light sources continued to be localized, either as light fixtures in the

ceiling, or as lamps or accent lighting located for specific uses like reading or security lighting.

As new forms of lighting emerge from technological advances, it is possible that a new paradigm for lighting design will emerge. At recent trade shows, companies like Verbatim are unveiling new light panels made from **organic light emitting diodes**, or **OLEDs**.

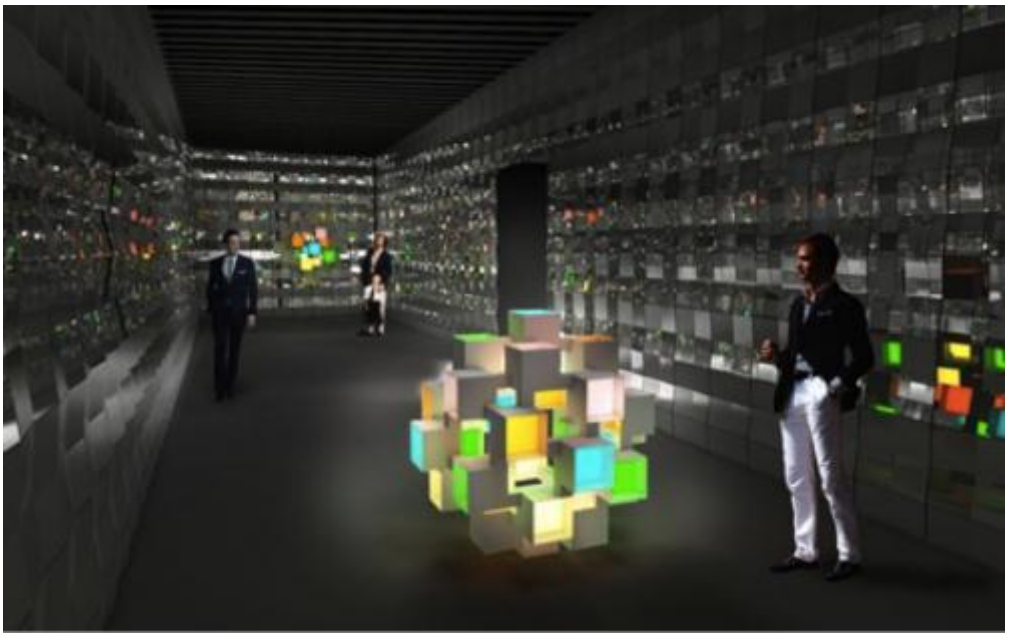

Figure 1 Source: www.specifile.co.za

Unlike conventional LED lighting, OLEDs are made from **organic molecules**, forming a material that can be manufactured as **thin, flexible lighting sources**. In order to get sufficient illumination from OLED lighting, the **surface** area of light emission needs to be **larger than the conventional point** source lighting.

Organic LED lights are **dimmable** and can be **color tunable**. They can emit white light that can either be bright, task-oriented light, or can be dimmed for softer, evening lighting. Designers can incorporate the lighting color and intensity into rooms as design elements.

While the integration of OLED lighting is appealing from a design point of view, the current cost of and OLED lighting source equivalent to a 60-watt incandescent bulb is over $2500 US. A recent market analysis study by Lux reports that this may fall to around $180 by the end of the decade, a cost that would still be at a level that is not competitive with other light sources, but is competitive with the cost of high-end light fixtures. Hence, if design elements are incorporated into the light source, consumers may not notice a difference in the total cost of lighting within a room.

Despite the expense, a white ceiling fixture consisting of 150 cm x 150 cm panels is currently under development by United Display Corporation (UDC), and is expected to be on the market within two years.

Figure 2 Source optics.org/news/1/4/29

The niche market for the product will include areas where it is undesirable to have any UV light emission, such as **museums** and **art galleries**, since OLED lights can be designed to have no UV emission. Homeowners who collect rare books or art may also appreciate this aspect of OLED lighting, as UV light tends to deteriorate antique or delicate materials.

A spokesperson from UDC expects that OLED lighting will be mixed with conventional solid state lighting in the future in residential applications where a combination of diffuse and point source lighting is desired. Even if prices fall in the near future, it is hard to imagine room lighting coming from a distributed source as opposed to a point source. This paradigm shift in lighting may prove to be a difficult adjustment for the average homeowner.

Under-counter Lighting in the Kitchen – Attractive, Practical, and Energy Efficient

A modern trend in home building and remodeling is to place lighting on the underside of kitchen cabinets. Typically, under-counter lighting is considered to be task lighting, because it is intended to provide adequate illumination for tasks that are performed on kitchen countertops.

Because under-cabinet lighting provides light at a point very near to the task, shadows tend to be less problematic than with lamps or other more indirect light sources. This kind of lighting is considered energy efficient because it provides illumination effectively at the point where it is needed, rather than throughout an entire room.

Under-cabinet lighting is presently available in incandescent, compact or linear fluorescent, or LED lighting. Unlike overhead lighting, under counter lights tend to come in linear strips, with smaller individual light sources, in order to provide more even lighting.

The Alliance for Solid-State Illumination and Technologies (ASSIST) rates under-counter lighting needs in the kitchen in terms of watts per cabinet. They recommend between 300 and 500 lux (unit of illumination) per each 24” to 28” (0.64 to 0.75 meters) cabinet. The lower level (300 lux) is appropriate for tasks such as reading a recipe or writing notes, while the higher level is more appropriate for cutting, chopping, and other activities involving sharp objects.

Lighting experts define the uniformity ratio of lighting on the counter as a ratio of the maximum light intensity at the counter top level to the average light intensity. This ratio should be 5 to 1 or less to avoid a “spotlight” appearance on the counter surface.

The uniformity ratio and watts per cabinet can be translated into a specification on the spacing and power level of individual lights. The number of lights needed and their spacing is highly dependent upon the type of lighting used.

Figure 1 Source: elementalled.com

Choices for under-cabinet lighting range from halogen "hockey puck" lights to linear LED strings, meaning wattage per cabinet can range from under 10 watts per light (for the more efficient LEDs) to over 150 watts per light (for incandescent xenon strip lighting). There are both line voltage and low voltage DC versions available. Newer products include dimmable LED under-cabinet "hockey-puck" lights.

The costs and lifetimes of under-cabinet lighting vary widely. Fortunately, there are a wide variety of options available for consumers, with even more coming on the market, so there are options for all ranges of personal tastes and budgets.

Dimmer Switches for Compact Fluorescent Light: Overcoming a Major Obstacle

One of the issues with **compact fluorescent lighting** (CFL) is the lack of ability to use CFL bulbs with **conventional dimmer switches**. Dimmer switches allow users to have a greater amount of control over ambient lighting in residential environments.

Conventional dimmer switches worked by using a variable resistor to limit the voltage delivered to a specific lighting circuit. This type of dimmer switch did not actually reduce energy consumption, since the "unused" power was dissipated in the switch resistor in the form of heat.

Modern dimmer switches work by changing the "duty cycle" of the AC voltage. The switch senses the voltage in the AC cycle, and switches on then the voltage reaches a certain level. Because the power delivered to a load is a function of the average power over a single cycle, the average power, and thus the effective voltage delivered to the load is reduced.

For a light source such as an incandescent bulb, this is an effective and energy efficient way to dim lights, since when the voltage is below the threshold level, no current is flowing and thus no power is dissipated. In CFL bulbs, however, this is a problem, and using a CFL bulb with a dimmer switch results in flickering of the CFL and reduced lifetime of the bulb due to stress on the electronics.

Manufacturers now produce **dimmable compact fluorescent bulbs**, but these bulbs often require special dimming switches to avoid common problems such as: bulbs turning off before the sliding dimmer switch reaches the minimum position; bulbs not turning back on until the switch is at its maximum position; and, lights turning off spontaneously, most likely due to fluctuations in the line voltage.

When selecting a dimmer switch to use with CFL bulbs, it is advantageous to look for one of the newer switches that will work on circuits that have both compact fluorescent bulbs as well as LED lights. This will provide the maximum amount of **flexibility** for future lighting options. It is also important to check with the manufacturer of the specific dimmer switch that will be used in a lighting application, as not all dimmable bulbs are compatible with every dimmer switch, even those dimmer switches designed specifically for use with CFL bulbs.