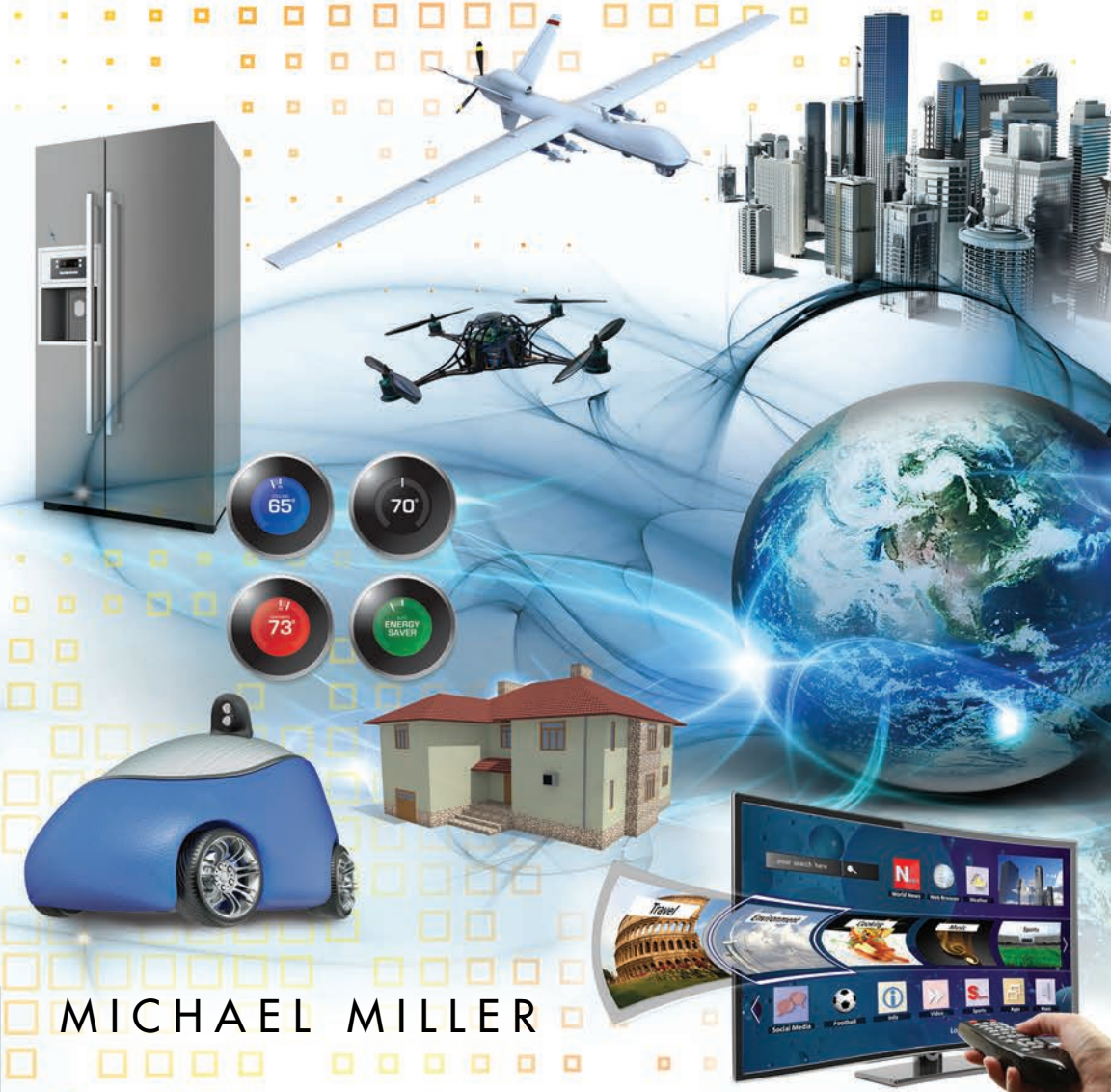
THE INTERNET OF THINGS

HOW SMART TVs, SMART CARS, SMART HOMES, AND SMART CITIES ARE CHANGING THE WORLD



MICHAEL MILLER

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Step 3: Automating Basic Functions

At this level, manual control gives way to automatic control, via programmed instructions. We're talking about automating such functions as controlling room temperature, cycling lights on or off at specified times, activating or deactivating the alarm system on a given schedule, running the outside sprinkler system according to a set program, and the like.

It's a matter of using technology, typically in the form of programmable timers, to do what you'd otherwise have to do manually. Instead of manually switching on this light or pressing that start button, the task starts whether you're there or not. You still have to tell the device to do its thing, but you tell it well in advance, based on the schedule you enter.

Step 4: Tracking and Taking Action

Now we get to the stage where your home starts watching you. Thanks to development in sensor technology, your home can now track what you do (and where) to determine activity patterns, sleep patterns, even your health status. Your home is converted into a giant monitoring system, and you're the subject.

What does your home do with all this data it collects about you? It uses programmed algorithms or basic artificial intelligence to make decisions based on that data. If your house knows you always get up at 6:00 a.m. during the week, it knows to turn up the heat, turn on the coffeemaker, and so forth. If you exhibit behavior contrary to your norm, your home knows to alert authorities that you may be sick or injured or whatever.

And it's not just taking action based on your activities. At this level, your home can act on unusual data from sensors throughout the house. If the temperature spikes in one room that might indicate a fire, and the house will sound the alarm, turn on the sprinklers, and call the fire department. If the water pressure suddenly drops, the house knows that there's probably a water leak, and it turns off the main line and calls a plumber.

Step 5: Prompting Activities and Answering Questions

At this level, your smart home knows more about you than you do. It will prompt you to take your daily medication, ride your exercise bike, feed the dog, and set out food for dinner preparation. You'll even be prompted to make any necessary phone calls, write a note to your son's teacher, and the like.

Given the inherent intelligence (and access to not only your household information but also the wide world of information available on the Internet), you'll be able to ask basic questions and get accurate answers. Ask your home, "What's the weather going to be like today?," "Do we have all the ingredients for the dinner dish I'm preparing?," "How many days till my wife's birthday?," and "What appointments do I have today?"

Step 6: Automating Tasks

The more your home knows about you and your activities, the more it can do for you; you won't even have to ask the questions. Your home will automatically schedule necessary maintenance and repairs for all its component pieces and parts, reorder medications before you run out, prepare grocery lists (and send them to the grocery to fill and deliver), run the robotic vacuum cleaner, and do just about anything else that it can do autonomously.

And this is the nirvana of smart home technology, at least as we envision it today: a house that is appropriately wired and necessarily informed, making its own decisions, and performing all manner of menial and important tasks. When your home becomes this smart, you can just sit back and enjoy it—or feel free to take a vacation, knowing that your home will run just fine without you.

Simple Components for a Smart Home

What technologies are required to create the smart home of our dreams? There are a number of items that are necessary—most of which we have in our possession today.

Sensors

As with all things in the Internet of Things, we need sensors to determine the status of our environment and of various devices. These sensors can be freestanding or built into other devices.

In a smart home, sensors are needed to detect temperature, humidity, light, noise, and motion. Specialized sensors detect smoke and carbon monoxide levels; proximity sensors detect whether doors and windows are open or shut. Sensors can also detect the status of a given device (on, off, and so on) and the location of devices and people. (And pets, too.)

Note

There are many different types of sensors that may find their way into your smart home. Companies such as Adafruit (www.adafruit.com) and SparkFun (www.sparkfun.com) are big in the sensor business, offering modular-sensing components such as microphones, cameras, thermometers, humidity and barometric pressure sensors, fingerprint scanners, motion sensors, luminosity (light) sensors, force resistors, infrared proximity scanners, magnetometers, accelerometers, and more.

Controllers

Controllers are necessary to send signals to other devices to initiate some sort of operation. In a smart home, a controller can be dedicated to a specific operation, or be part of a larger device (such as a smartphone or home computer) to control multiple devices.

Actuators

An actuator is typically a mechanical or electrical device that actuates a given activity. We're talking motors and switches, such as those in electronic light switches, motorized valves, and the like. Without actuators, nothing gets done.

Buses

A bus is the communication system that transfers data between devices in a smart home. Different types of buses transfer data according to different protocols; for devices within the home to communicate with one another, they must all be compatible with the same bus type.

Interfaces

An interface enables the communication between different devices or between humans and devices. In device-to-device communication, the interface is really just a digital protocol. In the case of human-to-device communication, the interface typically includes some sort of controller and display, so that the person doing the controlling can see what he's doing.

Networks

As we discuss shortly, all this communication within the home takes place over some sort of network, either wired or wireless. Most home automation today is done wirelessly, using Wi-Fi, Bluetooth, or similar proprietary networking technologies.

Smarter Living with Smart Furniture

Let's start our examination of individual items in the smart home with something that we all have in our homes—furniture. Now, it's hard to think of your couch or coffee table as being exceptionally smart, but where there's a will, there's a way.

South Korean furniture maker Hyundai Livart has partnered with that country's largest mobile carrier, SK Telecom, to combine smart home technology with traditional household furniture. Each item in the smart furniture line has its own built-in touchscreen that replicates the owner's smartphone display via mirroring technology. For example, the company offers a dresser with touchscreen displays in the cabinet doors, as well as mirrors with touchscreens built in (shown in Figure 5.1).

Figure 5.1 *The touchscreen display embedded into a smart mirror from Hyundai Livart/SKT.*

People can use these smart furniture items to surf the Internet, listen to streaming radio, display news and weather, search for recipes, and the like. Since we're talking smartphone mirroring, the furniture can also be used to make and receive phone calls. Future functionality will enable users to control room temperature, open and lock doors throughout the house, and monitor visitors via a front-door camera.

Or how about the ReST bed, from Responsive Surface Technology? This smart bed incorporates special fabric and sensors to track your sleep habits, and then uses that data to keep you comfortable when you toss and turn all night. The ReST bed features 18 air sensors that inflate and deflate according to your preferences and your nocturnal activity.

Then there's Luna, a smart mattress cover you can add to any bed. It's packed with sensors to monitor your sleep patterns, and then communicates the data it collects to a variety of other smart devices. For example, Luna can sense when you're about to wake up in the morning, and then instruct your smart coffee maker to start making coffee, tell your smart thermostat to crank up the heat, and even have your smart lighting system light up to brighten your morning. (Conversely, it can tell that same lighting system to turn off any still-lit light when you fall asleep—as well as make sure your smart locks are all engaged.) Luna can also analyze your sleep cycle, heart rate, and breathing rate to adjust its temperature in real time to improve your sleep experience.

Smarter Environment with Smart Lighting

Here's some pretty popular smart home technology that's readily available today. Smart lighting systems enable you to control the lights inside and outside your house. Lights can be controlled on a preprogrammed time cycle or configured to automatically shut off when a room is unoccupied—but turn back on when someone walks into the room.

These systems typically require the smart bulbs be plugged into some sort of physical bridge or gateway device. You then connect to the gateway via the system remote control or a smartphone app and send the necessary commands to all connected bulbs. (Figure 5.2 shows how it works with the Connected by TCP system.) For that matter, you can use the system to control the lighting in your house while you're away, over the Internet.

Even neater, smart LED lights can be configured to output a specific brightness or color. This lets you provide different levels and types of lighting for different tasks.

Figure 5.2 *The Connected by TCP smart lighting system.*

Note

One of the advantages of LED lighting is that the individual LEDs in a bulb can be adjusted to different brightness levels and different colors. You can't do that with compact fluorescent lamp (CFL) or traditional incandescent bulbs.

There are a number of companies offering smart lights and smart lighting control systems. These include:

- **Belkin**—Its WeMo Smart LED Bulbs can be controlled by the company's WeMo Link system. Insert a WeMo bulb into your lamp and then control it (over Wi-Fi or 3G/4G) with the WeMo Light Switch, WeMo Motion (motion detector), or WeMo App. The WeMo App lets you register each light bulb, rename it, and customize rules for its operation.
- **FX Luminaire**—Specializes in landscape and architectural lighting. The company offers a variety of LED lights that can be controlled via traditional programming or smartphone app.
- **Lutron**—Has long been a player in custom-installed, whole-house automated lighting systems. The company offers a variety of home automation solutions that enable you to control your home's lighting, window coverings, and heating/cooling systems—all wirelessly, using Lutron's controllers or smartphone apps.