

Smart Home Technologies

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Abstract

Predicting the future is virtually impossible, especially in the world of computing technology. Advances in technology are happening at an exponential rate. Everyday new technologies are developed while old technologies are improved. Uses of newly developed technologies are bringing new visions to society's daily life. People are affected by technology, no matter what type of jobs or lifestyles they have. For example, advances in the automobile industry have revolutionized the commute to and from work or school. Computers also have changed the way society is educated, works, and lives. In the last ten to fifteen years, the use of technology in the home has been a growing trend. The future of technology use in the home is a shift toward the smart home.

Keywords: Smart Home Technologies, Technology Challenges, Technology Changes.

1. INTRODUCTION

Predicting the future is virtually impossible, especially in the world of computing technology. Advances in technology are happening at an exponential rate. Everyday new technologies are developed while old technologies are improved. Uses of newly developed technologies are bringing new visions to society's daily life. People are affected by technology, no matter what type of jobs or lifestyles they have. For example, advances in the automobile industry have revolutionized the commute to and from work or school. Computers also have changed the way society is educated, works, and lives. In the last ten to fifteen years, the use of technology in the home has been a growing trend. The future of technology use in the home is a shift toward the smart home.

2. DEFINITIONS

What is a "smart home"? According to Michael J. DeMaria, "smart-home is a

generic term used to describe a wide range of products and facilities. Basically, smart-home technologies and devices add automation or add enhanced functionality to existing appliances – typically through a converged networked infrastructure" (DeMaria). In short, smart-home technology integrates normal everyday activities with automation of appliances, security, and comfort systems. Sophisticated computer controlled heating and air conditioning systems and remote sensing lighting systems are being developed to take comfort to the next level. Whole-home security systems, including lighting, sirens, and automated police, fire, and ambulatory notifications, are also becoming a standard in the smart home.

Smart homes are becoming more and more prevalent in today's society. The integration of most typical home systems gives homeowners more control and safety. Integrated systems that a person can find in a smart home include, but are not limited to, heating/ventilation, audio/visual, appliances,

and security. New construction is the ideal atmosphere for the design and implementation of a smart home system. Currently, any one of several networked solutions can be purchased and installed. However, once these systems are installed, it is very difficult to move them to a new location if the homeowner moves, or simply wants to rearrange one of the individual systems. The chart in the Appendix from the Institute of Electrical and Electronics Engineers, Inc. provides a simple outline of the today's basic smart home trends of today, and what we can expect in the future.

3. POSSIBILITIES

Companies daily are innovating new possibilities for the smart home. Some of these innovations include an oven/stove that also doubles as a refrigerator. This enables a homeowner to put a meal in the oven prior to going to work, then at a pre-programmed time the oven starts and cooks the meal so that it will be ready when the homeowner arrives. One other feature being added is network capability for the same device allowing users (homeowners) to remotely access the oven's interface, where programming can be initialized from anywhere at any time. If the user programs the oven for a turn on time of 4 p.m. and ends up late at work, the user is able to log on and cancel/delay the start time until they arrive home.

Other innovations found in the smart home are comfort based. Fully programmable heating and air conditioning systems not only allow homeowners to live more comfortably from room to room, but also save money on energy costs. Rooms that primarily remain unoccupied can be regulated at lower temperatures in the winter and higher ones in the summer, thusly reducing energy costs. Also, comfort improvements are being made with fireplaces and room lighting. Remote-controlled fireplaces, and lighting have become a must have in almost every new high end home. Remote controlled lighting consists of room sensors, networked lighting control units, and radio frequency remote controls. Another big innovation in smart home technology is remote access. "Anything you can do within the home you do remotely these days," said Pat Hurley,

director of research at TeleChoice, a consulting firm (Cohen). The ability to have your home connected to a worldwide network not only makes life easier, but also for a safer environment.

These improvements affect our lives in many different ways. Not only are these improvements convenience features, but they also provide safety. Although many technological innovations make society's lives easier, they also increase the risks of daily life. Not just physical security like violence or theft, but digital crime. Digital crime and security is becoming an increasingly talked about problem. Identity theft and harassment are two things that come to mind as possible threats. On a larger scale, the smart home could lead to a society more reliant on the developers of technology, and government interference to maintain regulations on those developers. Since technology is growing so fast, developers need to work twice as hard to keep security measures in place as the world becomes digital.

When constructing a smart home, the basic layout, design, and implementation are the starting point of its security. According to Dave Bursky of Electronic Design, "the heart of the future home resides some form of a central or distributed computing nexus, perhaps a server." (Bursky) Centralized home network servers are becoming the standard in new high end homes. For the average person, however, it will take another ten to fifteen years respectively before this trend will be a must have in every home. These home servers typically have a computer located in the basement or other area of the home that the majority of the household does not use. Its basic function is like any other server, and to distribute e-mail, internet service, and allocate storage space to all the other computers the household has. This server will be the heart of the smart home in which all appliances, lights, and comfort systems are connected. The centralized server also distributes the cable television or satellite signal (typically high definition), DVD, and most security functions (cameras, lighting, etc). As the chart above showed, the smart-homes of today are expensive and proprietary. Most systems offer a modular design of varying features, and system

types. As time passes on, more of these systems will become interchangeable, so that home owners can have systems even more flexible.

The digital home entertainment center displayed in Microsoft's 2000 edition smart home led to the development of the Media Center versions of Windows XP and now Windows Vista (Lai). Windows Media Center is good start for a server based smart-home. Most home server systems today run Microsoft's Media Center as a point of Digital Audio and Video Distribution. This is an example of how modular these servers are becoming with the use of one system base communicating with the same system language.

As components of server systems are becoming more modular, an increase in security will come. Hackers are constantly attempting to gain access to systems worldwide whether they're corporate or residential. In order to stop these attacks, servers will need to incorporate firewall protection both hardware and software versions, and other filtering software to ensure spam type e-mail, pop-ups, and any other malicious internet hacks. These servers could also possibly house crucial passwords or other private data from financial institutions, making digital security of the utmost importance.

4. ENHANCED SECURITY

Another aspect of the smart home that offers security and peace of mind is lighting. Proper lighting not only influences moods, but can also prevent crime. Remote controlled or automated lighting will bring home security to the next level. "People have been using smart-home technology for years in the form of light timers, detectors..." (DeMaria) DeMaria goes on further to say "For example, while you're away on vacation, your household lights might be on a timer, making would-be burglars think someone is home" (DeMaria). The movie "Home Alone" highlighted this type of lighting control when the character played by young Macaulay Culkin gets left at home by accident when his parents go on vacation. Thinking back to the sequel in the "Home Alone" series, the instance in which Culkin

also uses an inflatable clown and some string to simulate his father in the shower is a similar example of what can be done now, without the strings and toys. Computer scripting programs can be written to flicker and flash lights on and off to simulate the motion of a person walking around. Also, a randomizer can be written in, to give the simulation a more lifelike appearance (DeMaria).

Using automated lighting is still a young technology but is growing rapidly. Other ways lighting can help provide safety, is the integration of a radio frequency controlled lighting system. These systems offer a new way to turn lights on and off throughout the home when someone is home or not. By use of dimmers and keypads that replace standard light switches, one can turn lights on and off in the entire home, no matter what floor. These keypads use pre-programmed scenes to light the different areas of the home. Much as earlier during the movie "Home Alone," this light system can set a scene for 'vacation' or for shorter periods of time such as a trip to the store. Also this type of system offers the ability to integrate a garage door opener, so when arriving home, the simple push of a button activates the electric garage door opener, and turns on a series of lights, illuminating a path to the kitchen, up the stairs, and to the bedroom (or is customizable to that specific home). This type of system also allows functions like 'all on' and 'all off'. These features when activated will power all the light connected to the system on or off, which indefinitely helps with security in the event of a break in. Also available are indicators to show the status of the lights.

People who are constructing new homes or are upgrading current homes often consider the integration of a whole home security system or service. These systems or services, typically offer more 'personal' security as opposed to preventing digital crime or enhancing digital security. However, advances in this area of smart home technology, brings using these systems to a new era. Security cameras, motion sensors, and alarms are all taking on new forms and providing a more intricate security system.

The use of security cameras in the corporate environment has been used in many ways. Cameras are used to catch shoplifters, trespassers, and employee theft. Much like the corporate world, cameras are being used around residential homes, to keep a watchful eye over the residence. The cameras can be wired or wireless and tied into the homes central computer server so viewing can be made anywhere the homeowner has access to a computer. Also the cameras can be modulated into the satellite television signal or in some cases over the cable line. The modulated signal allows the cameras to be displayed on any television set in the home on certain channels.

Motion sensors and alarms are being tied together more often. The use of computer .wav files are being used in conjunction with more advanced motion sensors. According to Ms. Engebretson, "If an intruder were to invade protected grounds around a luxury home, for example, the .wav file could instruct occupants to move to a heavily secured room. Such functionality would be triggered only after off-site monitoring personnel had verified the presence of a human intruder" (Engebretson). These .wav files would consist of basic instructions or possibly just a simple verbal warning. Engebretson also goes on to explain "... the uses of an astronomical clock in combination with a motion detector to control infrared lighting used with outdoor cameras. Technicians program the system to turn on the lighting when a person trips the motion detector, but the click ensures that the command is ignored during daylight hours" (Engebretson). This extra security feature makes for a foolproof system ensuring the homeowner doesn't forget to change the batteries.

Smart-home technology has made many improvements to ensure occupant security whether it is physical or digital. A security issue less recognized is the use of smart home technology and elder people. Just in time for aging baby boomers, researchers test some bright ideas: sensors and other gadgets to help older adults stay independent longer (Gussow). Barry McCall, a network security analyst agrees with Gussow's point, in that he has seen a dramatic increase in clients and network traffic of health monitoring systems in

personal homes (McCall). Typically, older generations are the slowest to adapt to new technologies; therefore, the goals of developers will require extremely simple interfaces and hidden devices. Gussow interviews Eric Dishman, chairman of the Center for Aging Services Technologies (CAST). One of Dishman's points made to Gussow was "Even though a computer is in the background, it's not a computer experience; it's a phone and TV experience" (Gussow). The use of technology is generally intimidating to older generations, but Dishman's outlook should lower that intimidation.

The use of sensors, home networks, and automated functions opened a door for older people to stay independent longer. Motion sensors are used to 'see' when people fall, or over a period of time they 'learn' habits and can send alerts for predefined anomalies. ADT, a security system service, offers a QuietCare Service, that offer such things like caller ID that shoes a photo, name and relationship of the person calling for people suffering from Alzheimer's disease; pill bottles that give voice reminders when it's time to take medicine; and sensors in furniture, slippers and other devices to help monitor other activity (Gussow). These services will help keep elder people safe longer while living independently.

5. CONCLUSION

In conclusion, as technology grows at an exponential rate, new innovations are made daily to help protect society young or old. Security in the digital realm or physically are two areas that still remain an important issue in any home, let alone a smart home. As smart homes increase in popularity, and become more widely affordable, security features are becoming an integral part. Can there really be enough security in or around a home?

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Appendix

| Current | Future |
|---|---|
| Affordable in high-end homes | Standard features in every home |
| Vendor dependent | Open Standards and Do It Yourself Concept |
| Very expensive maintenance | Zero maintenance |
| Proprietary and Standalone | Integrated solution |
| <u>Not flexible and/or adaptable to new lifestyle</u> | <u>Modular and expandable</u> |

(IEEE Malaysia Smart Home Technology) Table 1

