SMART HOME SYSTEM

What if all the devices in your life could connect to the internet? Not just computers and smartphones, but clocks, speakers, lights, doorbells, cameras, windows, window blinds, hot water heaters, appliances, cooking utensils, you name it. And what if those devices could all communicate, send you information, and take your commands? It's not science fiction; it's the Internet of Things (IoT), and it's a key component of home automation and smart homes.

Smart home technology, also often referred to as home automation or domotics (from the Latin "domus" meaning home), provides homeowners security, comfort, convenience and energy efficiency by allowing them to control smart devices, often by a smart home app on their smartphone or other networked device. A part of the internet of things (IoT), smart home systems and devices often operate together, sharing consumer usage data among themselves and automating actions based on the homeowners' preferences.

The most features we can encounter in a smart home are

- Smart lightning systems, smart heating (Thermostat), smart security tools , smart locks.

Smart home network technology can be classified into two main types, which are wiring system and wireless system. In wiring system, the equipment will be connected into the main power supply directly, so the data will be sent to the devices to activate or deactivate them. There are many types of wires that people may want to install in-wall. Many home automations are connected through wiring system such as new wire (twisted pair, optical fiber), Power line, Bus line, etc. An example of outstanding technology is X10, which is open standard for home automation. X10 transmits binary data using the Amplitude Modulation (AM) technique. And X10 controllers send signals over existing AC wiring to receiver modules. Other technologies are Home Plug, Consumer Electronics Bus (CEBus), European Installation Bus, etc. In the wireless system, there must have two main elements that are sender and receiver.

Many new appliances use wireless technology to communicate with other devices. The example of wireless communication system are microwaves, Infrared (IR), radio frequency (RF), Wi-Fi, Bluetooth, IEEE 802.11, and so on. Furthermore, some of smart home network standard can work using both wiring system and wireless system. An example of wireless communication system for smart home is Z-wave, which is a reliable and affordable wireless home automation solution. Z-wave is a wireless RFbased method for instant remote control of appliances.

Smart home controller

Smart home controlling devices are used for managing the systems by sending data or signal to control the actuators. The examples of the controllers are not only the remote control, but they

can also be smartphones, tablets (iPad, Galaxy tab), web browsers and Short Message Service (SMS). Moreover, some of systems may have computer which works as center of the environment perception or the evaluation unit.

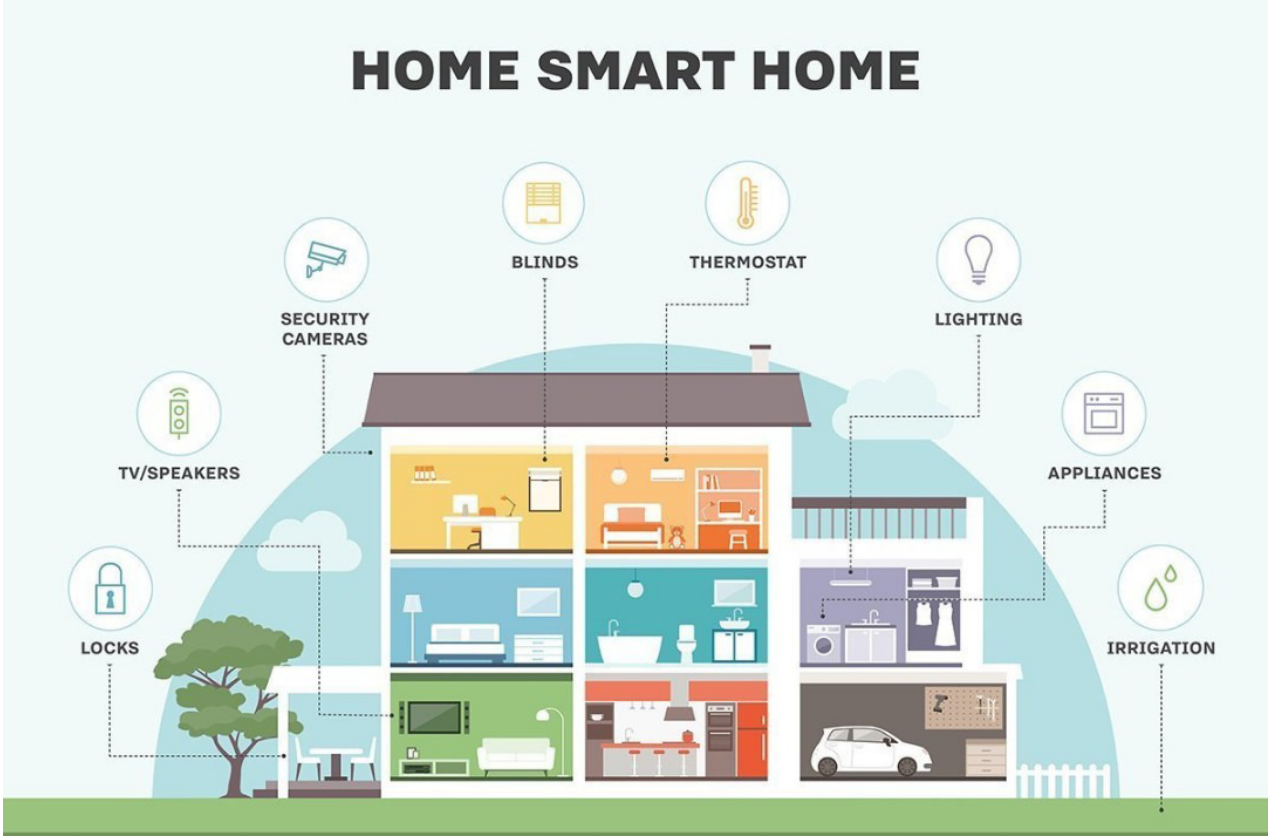
Due to a breakdown of the system, as devices are supposed to be controlled via wireless (Wi-Fi, Voice), it's also important to think about a manual relay to be able to interact with the devices manually.

Talking wireless, we can have different types of connectivity:

- Wi-Fi connection where all the devices and the controller are connected wirelessly via Internet.

- Bluetooth where all equipments are connected locally in a short range.

- Z-Wave where all the devices are connected wirelessly without a bride (i.e. Wi-Fi router)



Application Domains of Smart Home Systems

Smart lighting

It's one of the simplest and more accessible elements of the smart home devices as it's just an incorporation in a pre-done electrical circuit of the house. It can be controlled either by voice or remotely. Smart lighting works and is controlled through a bridge connected to Wi-Fi.

The elements required for a smart home system's lightning are:

- Smart light bulbs that can be connected to the bridge and that can also have different color spectra to create different visuals

- Bridge which is connected to the Wi-Fi router and then send the command to the bulbs.

- A remote controller to interact with the system in addition to an App or the voice command.

- An App installed on a Smartphone or tablet that has the different functionalities of all of our system.

Smart heating

Smart heating systems are systems designed to control wirelessly a thermostat to regulate/control the temperature via an app, voice command or also remotely.

It has to be installed by a qualified installer and then connected to the Wi-Fi of the home with a central heating system like a hub.

The main elements of the smart home system are:

- The heat thermostat that is connected to the boiler that heats the water (i.e. water heating) and also to the learning hub that receives instructions, treat them and/or store them.

- A Hub (smart thermostat) that connects to the heating thermostat and send the instructions.

Elevators and stairs

Elevators are installed at the middle of the stairs in most houses. This is highly necessary for the older people or people with limitations to get to the upper flats or to get to the attic. Furthermore, most houses have stair lift added to the stair either in the house or at the entrance.

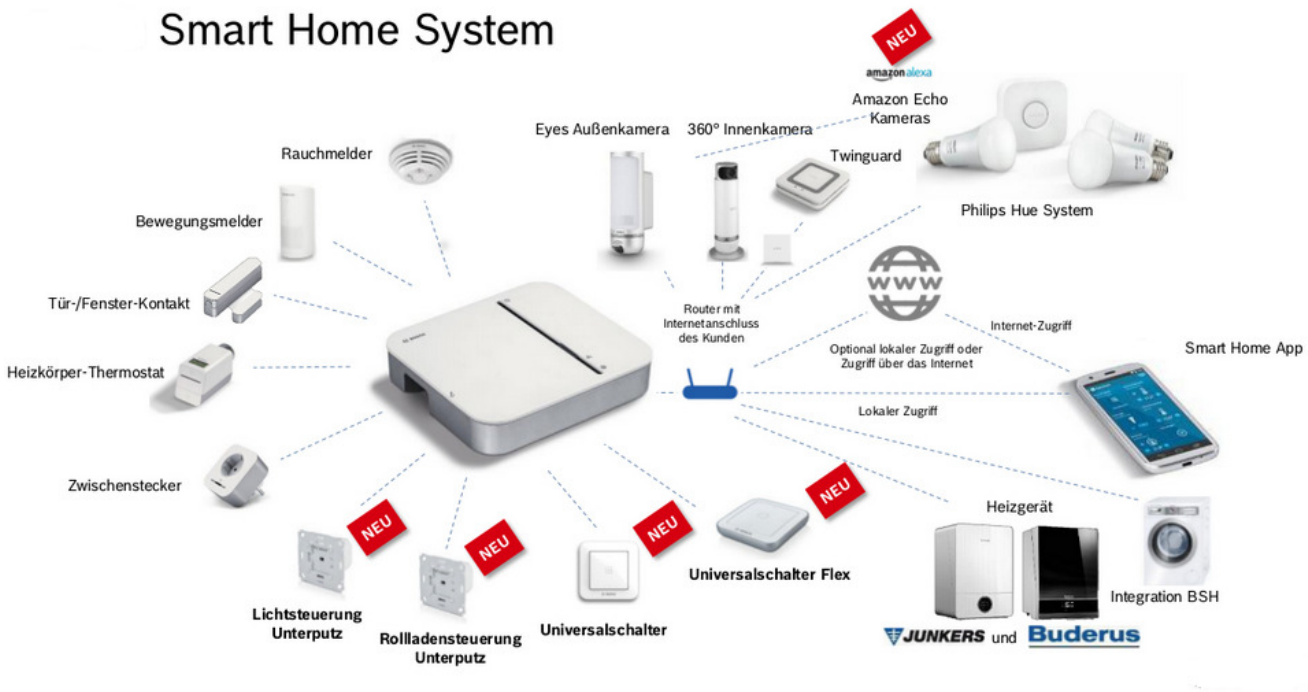
Automated Windows and Window Blinds

Automated windows and window blinds use electronic devices like sensors and actuators that are programmed to control windows and window blind switch remote controller. One can be either laying on the bed or sitting on sofa while operating or adjusting the blind because of its wireless nature.

As a result of the technological advances and increasing focus on energy efficient buildings, automatic daylight management systems are being developed. The algorithms for the blind's behavior are often optimized to achieve maximum energy saving in simulations. The automated windows and window blinds are meant for people who are perfectly healthy or in wheelchairs.

Surveillance cameras used in houses are IP cameras or closed circuit. IP cameras connect over the internet and stream to users' phones using a Wi-Fi connection. Closed-circuit, or CCTV cameras, stream through wired or wireless links. These cameras stream live footage to users, allowing them to watch for suspicious activity.

Home surveillance cameras used for security purposes have become more accessible and feature abilities such as motion detection and two-way audio, allowing users to receive notifications of activity and speak and listen through the camera.



Other Application Domains of smart home technologies

Nearly every aspect of life where technology has entered the domestic space (lightbulbs, dishwashers and so on) has seen the introduction of a smart home alternative:

- Smart TVs connect to the internet to access content through applications, such as on-demand video and music. Some smart TVs also include voice or gesture recognition.
- In addition to being able to be controlled remotely and customized, smart lighting systems, such as Hue from Philips Lighting Holding B.V., can detect when occupants are in the room and adjust lighting as needed. Smart lightbulbs can also regulate themselves based on daylight availability.
- Smart thermostats, such as Nest from Nest Labs Inc., come with integrated Wi-Fi, allowing users to schedule, monitor and remotely control home temperatures. These devices also learn

homeowners' behaviors and automatically modify settings to provide residents with maximum comfort and efficiency. Smart thermostats can also report energy use and remind users to change filters, among other things.

- Using smart locks and garage-door openers, users can grant or deny access to visitors. Smart locks can also detect when residents are near and unlock the doors for them.
- With smart security cameras, residents can monitor their homes when they are away or on vacation. Smart motion sensors are also able to identify the difference between residents, visitors, pets and burglars, and can notify authorities if suspicious behavior is detected.
- Pet care can be automated with connected feeders. Houseplants and lawns can be watered by way of connected timers.
- Kitchen appliances of all sorts are available, including smart coffee makers that can brew a fresh cup automatically at a programmed time; smart refrigerators that keep track of expiration dates, make shopping lists or even create recipes based on ingredients currently on hand; slower cookers and toasters; and, in the laundry room, washing machines and dryers.
- Household system monitors may, for example, sense an electric surge and turn off appliances or sense water failures or freezing pipes and turn off the water so the basement doesn't flood, for example.

- In Kitchen

The most heard about smart technologies are that of the kitchen. An example appliances which are smart are refrigerators, microwaves, coffee makers, and dishwashers. The Internet Refrigerator applies the technology of smart home to make many works much easier. There is Internet enabled and allows for users to communicate with it via the Internet, so it is able to download recipes and then display them on its LCD screen. Moreover, the refrigerator also takes an automatic inventory of items inside of it and it can alert the users to what is there. What’s more, microwaves are also smart. Microwaves can communicate with smart refrigerators and suggest recipes based on the food items available in the refrigerator. The microwave can even be set to start at certain times while users are away from home.

- In living room

Stepping away from the kitchen, one part of the home which has smart home technology adoption is living room. Smart devices like televisions and stereos will utilize this technology to improve the entertainment experiences. The smart TV will have many functions like desktop

Personal computer so this leads to interactive TV and more interactive content will become available. Furthermore, lighting control systems can be used to control household electric lights by using of motion detectors to automatically extinguish the lights in a room after people have left and turn on the lights if people enter a room.

- In Bedroom

The room has smart climate control which the users can set the scene in bedroom with single-touch heating and can choose a unique night-time temperature and lighting profile for each bedroom. The bed is also equipped with sensor that can monitor movement of a person in bed for detecting health condition regarding sleeping in typical routine of a person. Moreover, the smart devices can be used in many aspects, for instance,

• Welfare - Health monitoring, Personal trainer, remote diagnosis

• Entertainment - Television, video, games, Smart Home Theatre, Multi-Room Audio, HD Video Distribution

• Environment - Remote control of lighting and heating and air conditioning. Energy usage and cost.

• Security - Smart Security, simulated occupancy, property monitoring and protection, detection of fire, gas leaks and water leaks, tele-assistance.

• Communication - Video phone, home calendar, reminders and communication inside and outside the house

• Green - Reduce Electricity and heating fuel consumption.

People who are elderly or disabled benefit the most from a home automation system that employs artificial intelligence. These systems offer those who are less mobile, or in delicate health, the opportunity to be independent, rather than staying in an assisted living facility. Designing a Smart Home is also very crucial. This can be tough, putting together a home design that reflects your taste, yet also fits your needs and budget is a balancing act that takes planning.

Smart Home Challenges

- Security Smart home also comes with some security concerns. For instance, hackers can access the network system. They have the ability to control all smart devices especially the security appliances.

- Adaption to New Environment: Owning a smart home means having to learn how to use your home that requires you to adapt to many innovations around you such as security systems and many sensors that always detect your movement. Accordingly, it will take reading manuals and learning about how-to of your home.
- High Cost of Intelligence: Although smart homes have many properties that makes human's lives convenient, these smart properties are in a higher price tag. The cost of an intelligent home is high because some of the technology is relatively new. However, mostly of home automations are just a few advances that are standard in a new home, the cost of other aspects can be expensive as well.

One of the most touted benefits of home automation is providing peace of mind to homeowners, allowing them to monitor their homes remotely, countering dangers such as a front door left unlocked. This is also beneficial for the elderly, providing monitoring that can help seniors to remain at home comfortably and safely, rather than moving to a nursing home or requiring 24/7 home care.

Smart Homes helps consumers improve efficiency. Instead of leaving the air conditioning on all day, a smart home system can learn behaviors and make sure the house is cooled down by the time homeowners arrive home from work. The same goes for appliances. With a smart irrigation system, the lawn will only be watered when needed and with the exact amount of water necessary. With home automation, energy, water and other resources are used more efficiently, which helps save both natural resources and money for the consumer.

Smart future

The German smart home market will triple in volume to €4.3 billion by 2022, according to the study "The German Smart Home Market 2017-2022. Facts and Figures." The annual growth rate in the coming five years will thus average 26.4 percent. By comparison: Traditional industries, such as mechanical engineering, have an average maximum growth rate of six percent per annum. The rapid pace of technological progress means many innovative smart home elements will be used in just a few years' time. IKEA is working on a smart table that detects food with a camera and suggests recipes based on the ingredients. That reduces waste and enables existing food to be used better. In the future, smart mirrors will analyze our skin and recommend care products on that basis.

The popular vision in pop culture of the traditional robot as a home help will become reality in the coming years. The robot does the washing, serves food and drinks, and also provides the inhabitants with useful information on the side. We can follow the baking or cooking process live in the smart oven of the future thanks to a built-in camera. The toilet of the year 2030 will provide users with information on the state of their health and can even conduct pregnancy tests.

References

[1] Jackie Craven, “What Is a Smart House?” [Online], Available: http://architecture.about.com/od/buildyourhous1/g/smarthous e.htm. [2012, October 18].

[2] Saisakul Chernbumroong, Anthony S. Atkins and Hongnian Yu, 2010, “Perception of Smart Home Technologies to Assist Elderly People”, The 4th International Conference on Software, Knowledge, Information Management and Applications (SKIMA 2010), Paro, Bhutan, pp. 1-7.

[3] Li Jiang, Da-You Liu and Bo Yang, “Smart Home Research”, 2004, Proceedings of the Third International Conference on Machine Learning and Cybernetics, August26-29, Shanghai, pp. 659-663.

[4] Manfred Huber, 2006, “Smart Home Technologies” [Online], Available: http://ranger.uta.edu/~huber/cse4392_SmartHome [2012, October 18]

[5] iT24Hrs, 2012, “Smart room, smart home” [Online], Available: http://www.it24hrs.com/2012/smart-room-smart-roomautomation. [2012, October 18].

[6] Barthold, Jim, 2005, “Changing the Way Houses Operate” [Online], Available: http://articles.castelarhost.com/smart_home_technology.htm [2012, October 18].

[7] Smart3, “Rest easy with smart climate control in your bedrooms” [Online],Available:http://www.smart3.co.uk/rooms_smart_technology/ master_bedroom_suite.htm

[8] Christoffer Björkskog, “Human Computer Interaction in Smart Homes”, Helsinki, Finland, p.1

[9] Xiaojing Ye and Junwei Huang, 2011, “A Framework for Cloud-based Smart Home”, International Conference on Computer Science and Network Technology, December 24-26, Chongqing, China, pp. 894- 897.

[10] Shang-Yuan Chen and Yi-Feng Chang, 2010, “The Computer-Aided Design software for Smart Home Device based on Cloud Computing service”, Second WRI World Congress on Software Engineering, Taichung, Taiwan, pp. 273-278.

[11] D’Ulizia, A., Ferri, F., Grifoni, P., & Guzzo, T. (2010). Smart homes to support elderly people: innovative technologies and social impacts. In Pervasive and Smart Technologies for Healthcare: Ubiquitous Methodologies and Tools (pp. 25-38). IGI Global.

[12] Morris, M. E., Adair, B., Miller, K., Ozanne, E., Hansen, R., Pearce, A. J., & Said, C. M. (2013). Smart-home technologies to assist older people to live well at home. Journal of aging science

[13] Pal, D., Funilkul, S., Charoenkitkarn, N., & Kanthamanon, P. (2018). Internet-of-Things and Smart Homes for Elderly Healthcare: An End User Perspective. IEEE Access, 6, 10483-10496.

[14] Tatsuya Yamazaki, (2007), “The Ubiquitous Home”, International Journal of Smart Home, Vol. 2, No. 2, April, January 2007

[14] Aarts, E. & Marzano, S. (2003). The new everyday: views on ambient intelligence. Rotterdam, The Netherlands: 010 Publishers

[15] Ming-Hui Jin, Chung-Jung Fu, Chih-Hao Yu, Hung-Ren Lai, and Ming-Whei Feng, (2008), "I3 BM Zigbee Positioning Method for Smart Home Applications", International Journal of Smart Home, Vol. 2, No. 2, April, 2008