



# Survey of IoT-Based Smart Home Systems: Technologies, Applications and Challenges

1.Renuka Patel, 2.Dr.Swati Patel, 3.Prachi Maniyar

1 Assistant Professor, 2 Assistant Professor, 3 Assistant Professor  
Ganpat University, Mehsana, India

## Abstract:

This survey article seeks to present a thorough overview of IoT-based smart home systems by examining the technology, applications, and difficulties related to this developing industry. The study provides a thorough analysis of the literature that has already been published while emphasizing significant developments and market trends in IoT-based smart home systems. It explores the underlying technologies that provide seamless connections and clever interactions in smart homes, including sensor networks, cloud computing, and data analytics. In addition, it discusses outstanding research questions and significant obstacles in the areas of privacy, security, interoperability, scalability, and user acceptability, illuminating possible future possibilities in smart homes.

Technology for smart homes is quickly becoming an intriguing new paradigm. This article covers a wide range of topics, such as security, energy conservation, ventilation, and smart kitchens. Smart gadgets like remote controls, security alarms, sensors, etc. are used to carry out all of the aforementioned tasks. In this article, we outline the tools and technologies that may be included in smart home security and energy systems.

**Keywords:** Smart Home, Internet of Things (IoT), Home Appliances, Wireless Sensors, Lifestyle Automation

## Introduction:

The use of computers or microcontrollers to operate and monitor domestic equipment is known as "household automation". Nowadays, automation is common because it offers convenience, security, and efficiency. The web server that provides data about the condition of the appliances serves as a sensor in this update. If the user is far from the house, he or she may access the appliances and modify their state, turning them on and off. The user may use a local PC. This essay will provide a method for utilizing a web server to manage household appliances. [1]

These IOT-based smart security and smart home automation technologies aim to combine simplicity and comfort. Home automation and wireless home security are the two facets of this project. If any form of human activity is detected close to the entry of the owner's home, the system's prototype, as it is now constructed, sends notifications to him via Internet-based email. On the other hand, if the owner realizes that the person entering the home is not an intruder but rather an uninvited guest, he or she can take steps to welcome the visitor, such as opening the door and turning on several internal appliances that are also connected to and controlled by the system's microcontroller. [2]

Internet-of-Things: The network of computers that will link to physical items or things in the actual world using the current internet infrastructure. Things may be any kind of thing, such as furniture, equipment, automobiles, etc. The entire system is referred to as the Internet of Things (IoT) when these devices connect to the Internet using a defined infrastructure and accepted protocols.[3]

## Existing Methods:

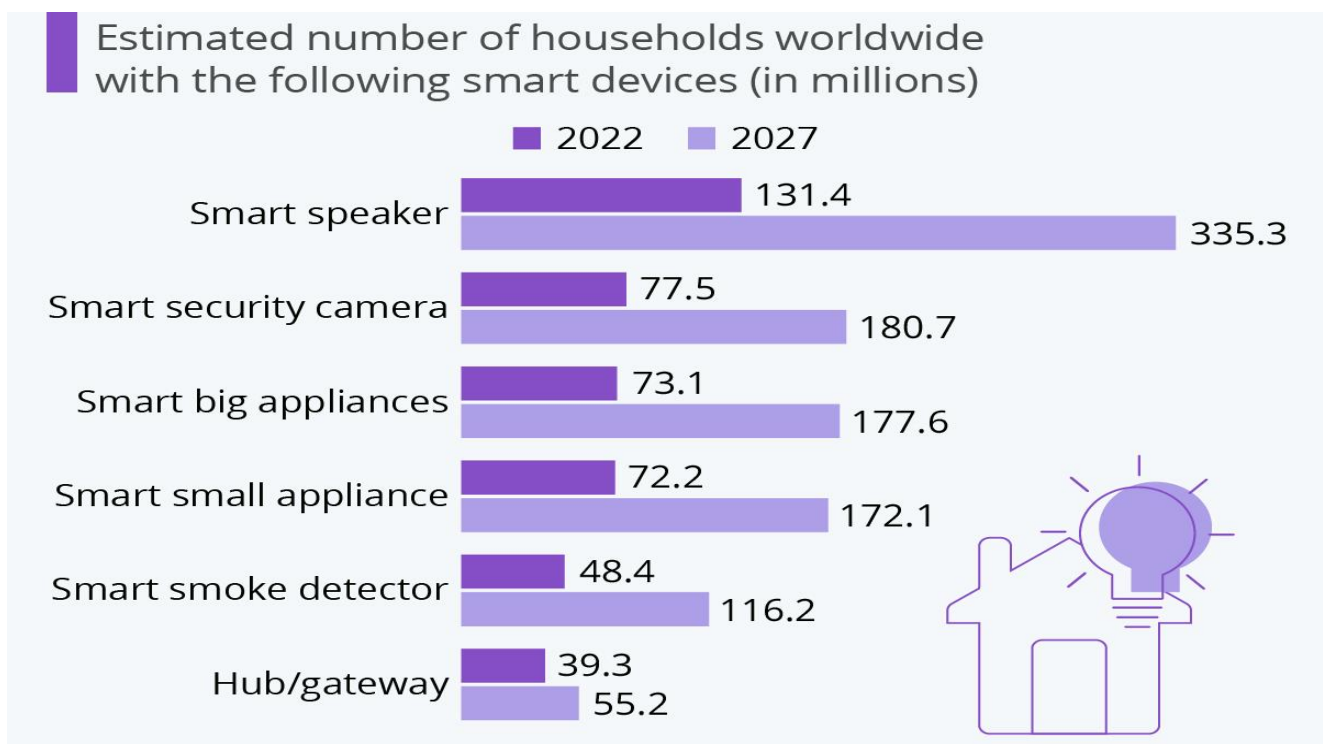
A system for home automation that uses Bluetooth, an Arduino board, and a smartphone is safe and affordable. A computer or smartphone serves as the receiving device for the Bluetooth system. It may be used as a real-time system because of its fast transmission rate, excellent security, and inexpensive cost. One of the biggest drawbacks of Bluetooth-based home automation systems is their restricted range of 10 meters, which prevents smartphones from controlling appliances if they are outside of range. [4]

## Present Technology

Smart home systems with IoT modules employ a variety of communication protocols, including Bluetooth, Wi-Fi, Zigbee, and 6LowPan. Bluetooth is used for near-field communication, such as device communication utilizing a mobile phone, and has a limited operational range. Wi-Fi allows for a quicker data transfer rate, making it more suited for running large networks.

## Graph1

### Smart Devices



## Case Studies:

The fundamental components of home automation were in use by the 1970s. Some people make technical advancements, which others then pick up on and develop further. A Scottish business created the X10 smart home gadget. By using simple remote controls or keypads (transmitters) with a command alert to the system and the specific unit ID numbers of the receiving devices that should receive the command as well as the codes for the action, such as switching on/off, X10 made use of the home electrical wiring to turn electrical appliances (receivers) on and off. Such a system was susceptible to failure because of the noise produced when electrical wires and connected gadgets were powered. Some systems have recently been employed in smart home applications.[6]

table 1

features of technology (wireless/wired)

Techno logy	Features		
	Wireless/Wired	Mesh	Wireless/ Wired Action
ZWave	Wireless: With embedded code for Zwave devices <sup>a</sup>	Yes	Master Slave
ZigBee	Wireless: Based on IEEE wireless Personal Network	Yes	Master Slave
Insteon	Both <sup>b</sup>	Dual mesh	Peer
KNX <sup>c</sup>	Both	Mesh	Peer

## The architecture of IOT-based Smart Homes System

There is a server and database connected to the LAN. The server manages the hardware, keeps track of its operations, generates reports, responds to inquiries, and issues the necessary orders. The smart home server transports data to the cloud for more involved or frequent operations and uses application programming interface procedures to remotely activate tasks on it. Additionally, because IoT home equipment is linked to both the LAN and the internet, smart homes now also contain IoT.

Hardware, software, and communication protocols make up a smart house. It may be used in a broad range of ways by digital consumers. Some home automation applications use IoT-enabled connections, including lighting control, gardening, safety and security, monitoring of water and air quality, voice assistants, switches, and water and energy meters.[7]

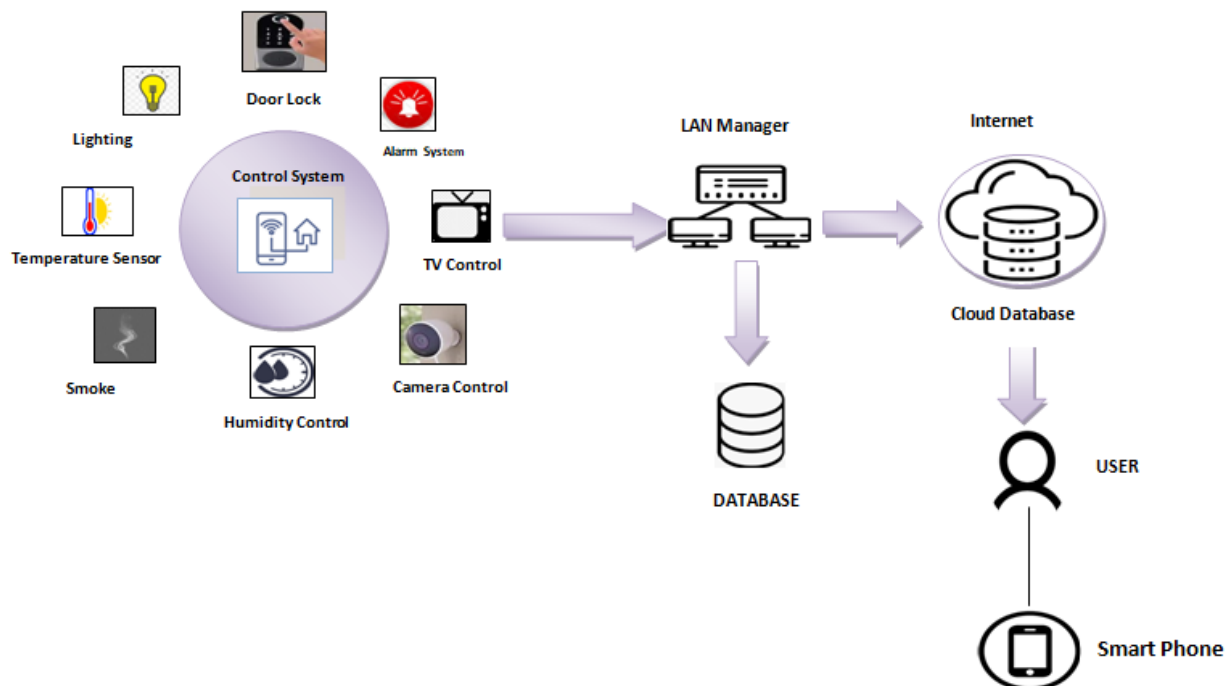


figure 1

control system

## The essential elements

The system is made up of the following elements, which are shown in Figure, to support all of the aforementioned actions and data management:

1. Sensors to gauge indoor and outdoor conditions and gather data about the home. Both the home and the attached-to-home gadgets are connected to these sensors. They are not Internet of Things sensors, which are affixed to household equipment. Data from the sensors is gathered and sent continuously to the smart home server through the local network.

2. Actuators set commands on the server or other control devices and carry them out. The necessary action is converted to command syntax, which the device may then perform. The task determines whether any rule became true while processing the sensors' data that was received. The system may issue a command to the appropriate device processor in this situation.

3. Database for processing and archiving sensor data [and cloud services]. Additionally, data analysis, presentation, and visualization will be done using it. The database that is associated with it stores the processed data for later usage. [8]

## Applications of IoT-Based Smart Home Systems and Devices

### Electricity: Lighting

Home lighting may now be automated to suit individual needs. For instance, customers may configure the lights to automatically decrease when they start viewing a movie so they won't be distracted from the story. You don't always need to push a button to have the lights come on when you enter your house.

Every electric appliance in your house may now be controlled or replaced by a smart device, including air conditioners, TVs, lights, vacuums, and even coffee makers. One can now use a smart device to control or replace any electric appliance in your home, including TVs, air conditioners, lights, vacuums, and even coffee makers. When the software is connected to your home environment, you may configure it to turn on or off when you leave, brew coffee at seven every morning, or take any other accessible action when specific criteria are fulfilled.

### Bathrooms

Your daily routine at home may be made more enjoyable and practical by using IoT technology in the bathroom. Smart mirrors may link to other devices like computers and smartphones, identify the faces of family members in their line of sight, and show information that interests those people, such as news articles, weather forecasts, or certain websites. If no one is using the restroom, special sensors can keep an eye on movement there and immediately shut off the water.[9]

### Gardens

Sensors may be quite useful for people who want to cultivate their fruits, veggies, and herbs. The technology enables users to verify on their smartphones whether the temperature is appropriate, as well as whether the plant is sufficiently hydrated and getting enough sunshine. [10]

### Smart Home: Kitchen

IoT devices using artificial intelligence technologies can simplify and improve the cooking process. Smart sensors can check the temperature, humidity, and smoke levels in your kitchen to make sure everything is in order. They can also check for carbon monoxide and smoke.

You'll now find Wi-Fi-enabled appliances in your kitchen, including toasters, wine coolers, gas and electric ranges, microwave ovens, coffee makers, pizza ovens, and faucets. Additionally, your laundry area has Wi-Fi-controlled washers and dryers and even a microwave.



figure 2  
fire alert sensor

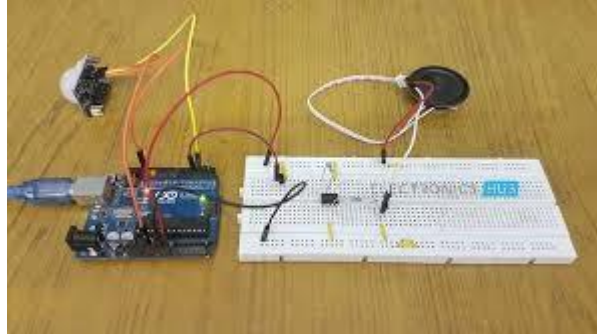


## Security Systems: Home Security

Do you constantly double-check that your doors and windows are shut and that the TV, computer, and other electrical equipment are turned off before leaving your house? With the use of specialized sensors, smart security systems will take care of things for you.

If you have an internet connection and are not at home, you can still access all of your IoT home automation on your smart phone.

Your house may be protected against burglaries, fires, and floods with the aid of window and door contacts, glass break and motion detectors, heat, smoke, and water detectors, security alarm pads, cameras, and smart doorbells.[2]



**figure 3**

*security alarm sensor*

## Smart Home: Heating & Cooling & Temperature Control

These controls can determine what you're doing right now and adjust the temperature accordingly. For a long time, programmable thermostats have been able to recognize and modify temperatures and humidity based on user preferences, including daylight, nights, weekends, vacations, and so on. With the advent of smart sensors and thermostats, a completely new range of capabilities is now possible.[11]

## Doors and Windows

In the future, doors won't require keys. The smart door may utilize face recognition to unlock your home. Any visitors who are not known to be occupants of the building must be granted entry by a resident. Additionally, the doors may be set up to open as you approach your house and close as you depart.[12]



**figure 4**

*door locking sensor*

## Climate

Busy individuals who want to return to a warm home in the winter or who want to warm up their homes before they get home from work might benefit from smart thermostats and fans. By automating temperature, ventilation, and humidity adjustments, home internet-connected devices can also contribute to effective energy management.[13]

## Leak Protection

The ability to detect water and gas leaks is built into some smart devices, such as sensors and alarms. When they identify leakage, you may program them to immediately alert you via alarms or smart phone alerts. Some people even go as far as installing IoT-based home automation that can contact a certified repairman to remedy leaks.

## Multimedia

Some of the most prevalent items you'll find in a smart home are speakers, televisions, video, and gaming equipment like Oculus and VR gadgets.

Our options have increased thanks to the availability of internet music and streaming services, which are also available on smart speakers and TVs.[14]

## Challenges (Aim and Objectives):

The Smart Home system is susceptible to a wide range of concerns, issues, and challenges. It is challenging to manage all of the apps in an IoT environment since they quickly grow in number. The question of how to govern and oversee these numerous, expanding uses arises. If these expanding applications were not properly and simply handled, the entire system could not be more safe and pleasant. On the server side, security is lower because no unique authentication technique is employed. This can result in a system that isn't secure. An attacker might enter the victim's house and destroy the smart home system. Another issue that could arise is connectivity. The issue of how to create connectivity also arises. [15]

## ADVANTAGES:

The following are a few benefits of this device: -

- Affordable smart IoT home automation system
- Because it is an automated system, it saves power.
- Utilizing a server, and maintaining household loads is simple.
- Can keep track of power use when loads are used
- Gas leak detection can track a safety concern.
- Anyone, wherever, can operate their smart.[16]

## Conclusion:

IOT-based home automation is a distinct idea from what is currently offered on the market. Automation would become simpler and more logical as a result. The system will be accessible to users wherever they are in the world. It is also crucial since it will make it easier for individuals to carry out their daily activities in today's hectic environment.

Every part of the world around us is rapidly transitioning to digital, and because of this, we must likewise move forward.

Our solution is a fantastic step towards automation; in the not-too-distant future, it will also offer security. We may grant access to our electronic gadgets no matter where they are on the globe since they are built on IOT. [17]

The characteristics of our system are as follows:

- A. Simple to use.
- B. Reduces needless power use.
- C. Cheaper than other automation systems in terms of price.
- D. Simple to use.
- E. Has a strong processing capacity and the ability to manage numerous tasks at once.

F. Employs a trustworthy wireless connection.[18]

## References:

1. IoT Based Smart Security and Home Automation System. (n.d.). Scribd. <https://www.scribd.com/document/383625534/IoT-Based-Smart-Security-and-Home-Automation-System>
2. Ghorpade, P. (2023, March 30). IoT and Edge Learning for Real-time Citizen Alerts in Smart Cities: A Comprehensive Review. IJERT. <https://doi.org/10.17577/IJERTV12IS030160>
3. Campbell, A. (2022, December 16). Guide to IoT Smart Home. \*HelpWire Blog\*. <https://www.helpwire.app/blog/iot-smart-home/>
4. Domb, M. (2019, February 28). Smart Home Systems Based on Internet of Things. IntechOpen eBooks. <https://doi.org/10.5772/intechopen.84894>
5. Armstrong, M. (2022, April 26). Homes Are Only Getting Smarter. Statista Daily Data. <https://www.statista.com/chart/27324/households-with-smart-devices-global-iot-mmo/>
6. Halvorsen, H. P. (2017, June 7). Case Studies in IoT - Smart-Home Solutions Pedagogical Perspective with Industrial Applications and some latest Developments. <https://hal.science/hal-01658856>
7. Campbell, A. (2022, December 16). Guide to IoT Smart Home. \*HelpWire Blog\*. <https://www.helpwire.app/blog/iot-smart-home/>
8. Djumanazarov, O., Väänänen, A., Haataja, K., & Toivanen, P. (2022, January 1). An Overview of IoT-Based Architecture Model for Smart Home Systems. Springer eBooks. [https://doi.org/10.1007/978-3-030-96308-8\\_65](https://doi.org/10.1007/978-3-030-96308-8_65)
9. Kodali, R. K., Jain, V., Bose, S., & Boppana, L. (2016, April 1). IoT based smart security and home automation system. <https://doi.org/10.1109/ccaa.2016.7813916>
10. Shapel, M. (2023, February 20). IoT and Home Automation. \*SaM Solutions\*. <https://www.sam-solutions.com/blog/iot-home-automation/>
11. Md. Sadad MAHAMUD | Master in Smart Systems Integrated Solutions (SSIs) | Aalto University, Helsinki | Department of Electronics and Nanoengineering | Research profile. (n.d.). \*ResearchGate\*. <https://www.researchgate.net/profile/Md-Sadad-Mahamud/publication>
12. Bhattacharyya, S. (n.d.). An Ultimate Guide To Buying Home Automation Using IoT | Analytics Steps. <https://www.analyticssteps.com/blogs/ultimate-guide-buying-home-automation-using-iot>
13. 7 Examples of IoT in Everyday Life. (n.d.). \*CBT Nuggets\*. <https://www.cbtnuggets.com/blog/technology/networking/seven-examples-of-iot-in-everyday-life>
14. Mocrii, D., Chen, Y., & Musilek, P. (2018, September 1). IoT-based smart homes: A review of system architecture, software, communications, privacy, and security. \*Internet of Things; Elsevier BV\*. <https://doi.org/10.1016/j.iot.2018.08.009>
15. Kumar, S., Tiwari, P., & Zymbler, M. (2019, December 1). Internet of Things is a revolutionary approach for future technology enhancement: a review. \*Journal of Big Data; Springer Science+Business Media\*. <https://doi.org/10.1186/s40537-019-0268-2>
16. Khanna, A., Arora, S., Chhabra, A., Bhardwaj, K. K., & Sharma, D. K. (2019, January 1). IoT Architecture for Preventive Energy Conservation of Smart Buildings. \*Studies in Systems, Decision and Control\*. [https://doi.org/10.1007/978-981-13-7399-2\\_8](https://doi.org/10.1007/978-981-13-7399-2_8)
17. Doshi, A. (2021, August 10). IoT based Home Automation. \*International Journal for Research in Applied Science and Engineering Technology (IJRASET)\*. <https://doi.org/10.22214/ijraset.2021.37287>
18. Kumar, V. S. A., & Chawda, R. K. (2020, July 31). A RESEARCH PAPER ON SMART HOME. International Journal of Engineering Applied Science and Technology; IJEAST. <https://doi.org/10.33564/ijeast.2020.v05i03.088>