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Security of Smart Homes in Cloud-Based IOT Environment

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Abstract:
Integrating Internet of Things (IoT) and Cloud Computing has the concept of Smart Homes that enables automation, remote monitoring, and energy efficiency. This review paper represents a comprehensive review of architecture, challenges, and applications associated with deploying IoT and cloud-based problem solutions in the Smart Homes area. Explore the various architecture models, including the edge, fog, and cloud-centric designs. An analysis of the impact on the latency, scalability, and security. Moreover, it will examine key applications like smart energy management, home security, and security itself. Focusing on the benefits and limitations of current implementations. This review focuses on the critical problems related to the privacy of data, interoperability, and the management efficiency of heterogeneous devices. The paper shows how to provide a valuable overview of the current state of the research and identify potential directions for future advancements in IoT and Cloud computing in Smart Homes.

Keywords:
Internet of Things (IoT), Cloud Computing, Smart Homes, Home Automation, Security, Privacy, Energy Efficiency, Fog Computing, Edge Computing.

I. INTRODUCTION:

The Rapid increase of Internet of Things (IoT) devices has help in a new era of connectivity, by transforming the traditional Homes into the intelligent and adapting areas. Smart Homes, which are enabled by the IoT and Cloud computing offer unmatched levels of convenience, comfort and efficiency through the automation control and remotely management of various home appliance and the systems.

The main idea behind the smart home is to interconnect a large range of devices including sensors, actuators and appliances to create the network that can collect, process and respond to environmental data. Cloud Computing has a role in providing the necessary infrastructure for storage of data, processing and analysing, enabling complex applications and services.

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The integration of IoT and Cloud computing in smart homes addresses different key needs:

- Convenience and Conformable: Automated lighting, controlling of the temperature and management of appliances improving daily living.
- Energy efficiency: Real time monitoring and optimization of the energy consuming reduce waste and cost.
- Security and privacy: intrusion detection, surveillance and emergency alerts enhancing home security and privacy.
- Assistance in living: Smart Homes technology supports independently living for elderly and the disabled people living in homes.

However, the impacts of IoT and cloud Computing in smart home is not without their challenges. The research paper aims to provide a comprehensive review of current state of research.

II. LITERATURE REVIEW.

A. Architecture Models.

This traditional method centralizes data storage and processing in the cloud. The studies like [10] have explored that the initial applications of Smart homes depend on heavily cloud servers. In this version sensor data from devices like Smart thermostats and Security cameras are pass on the cloud for analysis and action. For example, a Cloud based system might analyse temperature data and remotely adjust a thermostat. While offering scalable and managing centralized Management, and demonstrated in cloud-based platforms like Google nest, this architecture suffers from latency issues, especially for the real time applications. Bandwidth consumption is also a concern, as data must traverse the internet.

B. Security and Privacy

Smart Home in security and privacy are crucial, as interconnected devices can be vulnerable to data linking and cyberattacks, necessitating robust measures to protect both your personal information and physical security. For-Example [13] revealed some gaps in the communication protocols of Internet of Things devices and [20] proposed a method for data aggregation to protect users' Privacy in smart homes.

C. Data Management and Analytics.

IOT devices in smart home act as data sources. Example thermostats, security cameras and so on. They act as data sources, constantly collecting information about their operation and environment. For-example research by [9] investigated the use of machine learning algorithms in predicting energy consumption analysis. Cloud storages are scalable; Cloud platforms provide scalable and flexible storage for large volumes of data generated by these devices offering a cost-effective solution. For-example research by [12] examined the skills for data storage efficiency in cloud based smart homes.

D. Interoperability and Standards:

The Interoperability and Standards are the main key elements in IoT. The devices are able to communicate with each other seamlessly and adoption of consistent technologies and enable Standards greater compatibility and seamless integration of IoT devices. For-example the research by [22] analysis of the challenges facing Interoperability in heterogeneous smart homes. And also review paper by [24] explained on existence of Standards for IoT devices in communication.

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III. BACKGROUND:

Home automation systems have evolved significantly from their origins, which relied on simple programmable devices and standalone controllers. With the advent of the Internet of Things (IoT) and cloud computing, smart homes have transformed into powerful intelligent ecosystems that deliver automation, security, and energy efficiency.

A. The Role of IoT in Smart Homes.

Internet of Things (IoT);
Refers to devices with sensors, software and technologies for that can connect and exchange data with other devices.
Characteristics of IoT;

- IoT Connectivity; Enhances devices, sensors, and systems can connect and communicate with each other.
- Data collection; Includes using devices and sensors to monitor and measure data real time.
- Remotely control of Physical devices; Includes integrating sensors and actuators into physical devices, linking them to network framework.

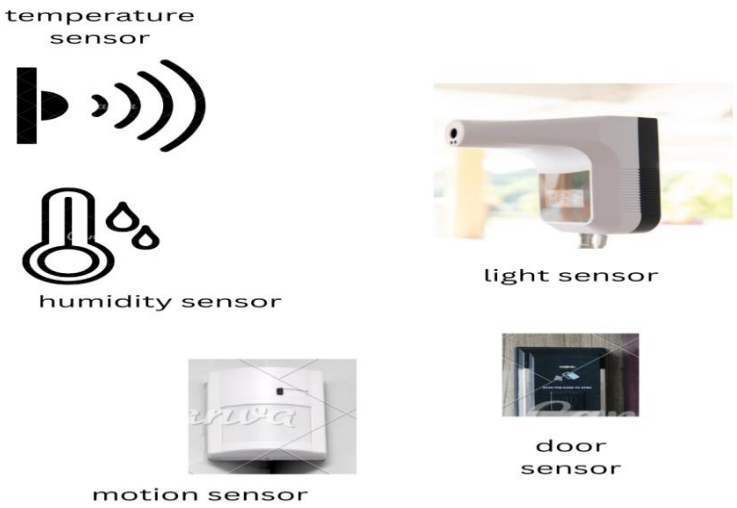
Internet of Things (IoT) in Smart Homes;

Provide overall roles like types of IoT Devices that mainly used in smart homes this includes;

Sensors;

- Temperature sensors; Are sensors device which measure and transmit temperature data through network that enables to control the temperature.

Fig 1. Sensors



- Motion Sensors; Are sensor devices that detect and measure movement within an area, enhancing devices to cooperate with surroundings and trigger alerts.
- Light Sensors; Are sensors that play a role by detecting and converting light energy into electrical signals.
- Humidity Sensors; Are sensors which helps in maintaining of optimum conditions smart homes.
- Door/ window sensors; Are sensors that detect if door or window is open or closed, mostly uses magnetic technology.

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Actuators

- Door locks; Is an electronic device which allows access control to a door using digital methods.
- Smart Plugs; Is an electronic device which connects to a standard electronic outlet allowing remotely control.

Smart Appliances;

- Refrigerators; Is a device that connects to internet and features sensors, touchscreens and cameras.
- Washing Machine; Is a washing machine that connects to the internet and provide features like remote control and notifications.

Fig 2. Smart appliances

Communication Protocols;

- Wi-Fi; Is a wireless network technology that uses radio waves to provide wireless high- speed Internet speed.
- Bluetooth; Is a short-range wireless technology that allows devices to communicate with each other without wires.
- Zigbee; Is a low power short-range wireless technology used for creating mesh networks, primarily for IoT applications.

B. The Role of Cloud Computing in Smart Homes.

Cloud Computing is the pathway of computing services over the internet. Enables users to easily access data, applications and development devices from anywhere with connection from internet.

Advantages of Cloud Computing in Smart Home:

- Security; Cloud features provide cloud security such as specialised software to protect software and secure data.
- Scalability and flexibility; Cloud provide the framework that requires to manage the enormous amount of data produced by IoT devices.

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- Cost Efficiency; Cloud manages and reduces the capital cost that the organisation has to spend on it.

Cloud Based Architecture in Smart Home;

1. Perception Layer;

- Sensors; Collect data from surroundings like humidity, motion and temperature.
- Actuators; Control tools like light, door locks, and thermostats.

2. Network Layer;

- Communication; Allows data transmission between devices and cloud.
- Protocols; Utilise various protocols like Wi-Fi, Zigbee and Bluetooth.
- Gateway; A device that links local network and the cloud.

3. Cloud Platform;

- Data Processing; Execute analytics, machine learning and other works to give insights and automate actions.
- Data Storage; Stores data collected from sensors and actuators.
- Cloud Services; Provides services like managing devices, storage of data and application development. Example; Azure and AWS.

4. Application Layer;

- User Interaction; Enables users to control and monitor their smart home by using mobile apps, voice assistants and web interfaces.

5. Security Layer;

- Protection; Enables the security of the system in IoT and encryption in data.
- Significance; Secures the system from unauthorised access and cyberattacks.

Fig 3. Cloud-based in the smart home.

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This paper decisively addresses the architectural models, security risks, data management strategies, and interoperability challenges faced by smart homes today. It presents an in-depth analysis of current research while proposing assertive future directions for enhancing IoT and cloud-based smart home solutions.

Table 1: LITERATURE SURVEY.

Ref No	Paper Name	Datasets	Results	Gaps
[10]	Internet of Things (IoT) Framework for Smart Buildings with cloud computing.	Not Used	Shows a framework used to give the needed computational power to Smart Buildings by using Cloud Computing	Data Security
[2]	Smart Home; Integrating Internet of Things with Web Services and cloud computing.	Sensors; The data collected using sensors are; readings from temperature and percentage in humidity.	Enclosing intelligence into sensors and actuators using Arduino platforms	Scalability and security
[3]	Design and Implementation a Cloud Computing System for Smart Home	Temperature sensors. Humidity sensors. Motion sensor	Designing and implementation of cloud computing system for Automation of smart home.	Security, Scalability, Long term maintenance.
[4]	An Integrated Cloud Based Smart Home Management System with Community Hierarchy.	Environmental Sensors. Wireless Devices.	System that manages the workload of community management stuff.	Comparison in MQTT and HTTP. Absence of follow up.
[5]	Smart Home Automation Using IoT with Cloud Computing.	Humidity sensors; Temperature sensors. Sound detection.	Proposed system for IoT devices, central hub.	Sensor accuracy.
[6]	Review on Smart Home Automation System using with Cloud Computing	Data from sensors and devices within smart homes.	Designing secured smart home automation application.	Data protection. Data security.
[7]	Smart Homes Automation System using cloud computing based on enhancement security.	Sensors.	Building Smart Homes that enhances home control management and monitors entrances.	Latency Reduction. Storage of data. Data security.
[8]	Internet of Things for Smart Homes and buildings: Opportunities and Challenges.	Wireless devices.	Evolving Smart Home and Building solutions based on IoT and Cloud Computing.	Performance. Data accuracy.
[9]	A review of Internet of Things for smart home: Challenges and Solutions.	Not used	Contribution in narrowing the gap between the existing state of art Smart Home applications.	Present and Future limitations for IoT based solutions.

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CONCLUSION

In this paper, encourages in Smart Homes privacy and security of the data, interoperability and managing the efficiency of heterogeneous devices. The paper has explained on integration of IoT and Cloud Computing to perceive the vision of Smart Homes. The discussion on Architectural framework and applications has encouraged security, efficiency of energy and convenience within residential environments.

In another way the perceiving of entirely autonomous and seamlessly integrated Smart Homes is not without limits. Matters like security and privacy of data, interoperability between heterogeneous devices, network latency and require robust and reliability in systems stay critical areas for future research and advancements.

Guidance in future, this work will likely base on enhancing artificial intelligence integration for predictive and personalised automation, the advancement of more secure and privacy preserving architectures, increased interoperability through universal standards

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