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APPLICATION OF SMART TECHNOLOGY IN INTERIOR DESIGNING

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CHAPTER 1

1.1 GENERAL

INTRODUCTION

In the swiftly evolving landscape of technology, one trend that has profoundly reshaped our day-to-day lives is smart home automation. This remarkable innovation has turned science fiction into reality, making our homes not just passive structures, but interactive spaces that respond, learn, and even anticipate our needs. From voice-activated lights and self-regulating thermostats to remote-controlled security systems, the “smart home” concept has transformed our interaction with the domestic sphere.

Every futuristic innovation is built on a foundation laid by the inventions of the past, and understanding the history of smart home automation provides valuable insights into how our homes got ‘smart.’ This understanding not only enlightens us about the past but also helps us appreciate current technologies more and anticipate future trends.

Let’s step back in time, to when the seeds of home automation were just beginning to sprout. The term “home automation” today may conjure images of AI-powered speakers and smartphone-controlled lights, but the concept, at its heart, is not a product of the 21st century. Instead, it’s been a gradual process, intertwined with human progress itself.In a broad sense, home automation refers to the use of systems and technologies to perform household tasks and functions automatically. The goal has always been to improve convenience, comfort, and efficiency. The means and methods, however, have evolved significantly over the years.

The history of smart home automation truly begins with the advent of electricity in the late 19th century. The power to harness electricity not only lit up our homes but also sparked a revolution in domestic life. The introduction of electric power led to the development of the earliest labor-saving devices – the precursors of smart home automation. Devices such as the electric washing machine, the refrigerator, and the vacuum cleaner began to ease household tasks, setting the stage for the future.

The invention of the telephone in the late 19th century was another significant milestone. It introduced the idea of remote communication, a concept central to modern smart home technologies. In the 20th century, we find ourselves amidst a bustling era of innovation and

discovery. The post-war boom, the surge in consumerism, and rapid advancements in technology combined to accelerate the history of smart home automation.One small but significant invention that laid the groundwork for remote control in home automation was, indeed, the remote control itself. Introduced initially for television sets, the remote control, brought convenience right to our fingertips.

The mid-20th century also witnessed the birth of home security systems. Advances in electronics led to the development of alarms and surveillance systems, allowing homeowners to monitor and secure their homes like never before. This added a new dimension to home automation, expanding its role from just convenience and comfort to safety and security.But, perhaps, the most groundbreaking innovation of this era was the development of home computer systems. The advent of personal computers in the late 20th century was a game- changer that propelled the history of smart home automation forward. Suddenly, advanced control and programming capabilities became accessible to the average household. As computer technology evolved, so did its applications in home automation.

As we journey further along the history of smart home automation, we reach a pivotal point — the dawn of the digital age. This era, characterized by the rise of the internet, mobile devices, and wireless technology, has catalyzed some of the most rapid and transformative changes in the realm of home automation.The advent of the internet was truly a watershed moment. It turned our world into a global village, changing the way we communicate, work, learn, and play. But its impact didn't stop there. The internet also unlocked the door to the 'smart home.' With the ability to transfer data over networks, devices in our homes could now communicate with us, and

more importantly, with each other. This interconnectivity laid the groundwork for our homes to become truly 'intelligent.'

Next came the rise of mobile devices and smartphones. Suddenly, control of our smart homes was literally in the palm of our hands. Whether it's adjusting the thermostat, checking security cameras, or turning off lights, we could do it all from anywhere, anytime. The history of smart home automation was changed forever.Wireless technology also played a critical role. The development of technologies like Wi-Fi, Bluetooth, Zigbee, and Z-Wave meant that devices could communicate without the need for physical connections. This removed many of the logistical barriers to home automation, allowing for greater flexibility and ease of installation.

1.2 SCOPE OF WORK

Smart Home Technology allows clients to control various aspects of their home environment, such as lighting, heating, and cooling, using a smartphone or tablet. Interior designers can now design homes with integrated smart home systems, making it easier for clients to control their homes' environment. Smart home Technology has become increasingly popular in recent years, and interior designers have been quick to adopt it.

IoT allows for a smart, connected home that responds to your needs. You can customize home automation systems based on your preferences. Control lights remotely via smartphone or voice commands, Smart thermostats , Sensors detect unusual activity and send alerts, Control home entertainment systems via smartphone or voice command, Automated Window Coverings, AR tools allow visualizing furniture and decor in your space before purchasing. Imagine trying out a new couch virtually in your living room, VR experiences transport you to different spaces. You can virtually explore room designs, layouts, and materials, AI can make personalized design recommendations based on your preferences and habits. These enhance safety, convenience, and functionality within spaces. They contribute to the personalization and ambiance of interiors,Customizable Lighting, Smart Clocks, and 3D Paintings

1.3 OBJECTIVE

- The objective is to introduce the field of interior design as one of the forthcoming parties in smart technology implications.
- Interior design is a multi-faceted profession in which creative and technical solutions are applied to achieve a built interior environment.Designers can bring their ideas to life and create realistic visualizations of their designs while increasing efficiency throughout the

entire design process.

- Smart technology has revolutionized the field of interior design by offering a myriad of benefits and possibilities.
- The objectives of smart technology in interior designing are vast and diverse. Firstly, smart technology aims to enhance the functionality and convenience of living spaces by introducing automated systems that can control lighting, temperature, and security with ease.
- smart technologies seek to improve energy efficiency and sustainability by integrating features like smart thermostats and lighting controls.

CHAPTER 2

LITERATURE REVIEW

Ayman Fathy Ashour ,Published on 12/18/2023- Smart Technologies in Interior Design.The recent decade has seen a remarkable surge in the development of technology, worldwide connectivity, and the networking landscape. These advancements have laid the foundation for smart interior design strategies, providing fertile ground for designers to investigate the potential impacts of integrating smart solutions into various facets of interior design. This practical methodology has demonstrated a significant positive effect on boosting the overall performance and functionality of buildings. The incorporation of smart solutions into interior design principles has proven to be more than a mere trend. It's a functional, efficient approach that not only enhances the aesthetic appeal of a space but also improves its practical use. In a broader context, this design philosophy carries the potential to conserve global resources, fostering healthier, advantageous, and more comfortable surroundings. Additionally, it bolsters the advancement of technologically driven lifestyles. This article provides a review of the theoretical principles that underline smart design and its practical applications. It delves into the exploration of the advantages associated with interior design strategies that seamlessly blend smart technologies.

Almssad, Published on 10 March 2023- Enhancing Smart Home Design with AI Models: A Case Study of Living Space. The normal development of "smart buildings," which calls for integrating sensors, rich data, and artificial intelligence (AI) simulation models, promises to usher in a new era of architectural concepts. AI simulation models can improve home functions and users' comfort and significantly cut energy consumption through better control, increased

reliability, and automation. This article highlights the potential of using artificial intelligence (AI) models to improve the design and functionality of smart houses, especially in implementing living spaces. This case study provides examples of how artificial intelligence can be embedded in smart homes to improve user experience and optimize energy efficiency. Next, the article will explore and thoroughly analyze the thorough analysis of current research on the use of artificial intelligence (AI) technology in smart homes using a variety of innovative ideas, including smart interior design and a Smart Building System Framework based on digital twins (DT). Finally, the article explores the advantages of using AI models in smart homes,
emphasizing living spaces. Through the case study, the theme seeks to provide ideas on how AI can be effectively embedded in smart homes to improve functionality, convenience, and energy efficiency. The overarching goal is to harness the potential of artificial intelligence by transforming how we live in our homes and improving our quality of life. The article concludes by discussing the unresolved issues and potential future research areas on the usage of AI in smart houses. Incorporating AI technology into smart homes benefits homeowners, providing excellent safety and convenience and increased energy efficiency.

Anushka Sharma,published on 2019-Focusing and addressing the problems faced by the differently abled people such as visually, audibly and vocally challenged, through a single device is a tough job. A lot of research has been done on each problem and solutions have been proposed separately. But not all of them are addressed together. The aim of the project is to create a single device solution in such a way that is simple, fast, accurate and cost-effective. The main purpose of the device is to makethe differently abled people, feel independent confident by seeing, hearing and talking for them. The paper provides a Google API and Raspberry Pi based aid for the blind deaf and dumb people. The proposed device enables visually challenged people to read by taking an image. Further, Image to text conversion and speech synthesis is done together .

Baoshi Sun ,published on 13 February 2020- Illumination is one of the most important environmental factors in the classroom. Researchers have discovered that lighting settings have significant impact on students' performance. Although light-emitting diode (LED) lighting systems can precisely control brightness level and correlated color temperature (CCT), existing designs of LED lighting control systems for classrooms are focused on energy-saving but lack context-based illumination control ability. In this study, a smart lighting system with continuous

evolution capability was developed. It can adjust brightness, CCT, and illuminance distribution dynamically according to specific learning context. This system allows not only manual control, but also automatic switching of scenes by integrating with school schedules. Based on existing knowledge about lighting preference, 10 lighting modes confined in the comfortable zone of Kruithof curve were proposed for various classroom scenarios. Moreover, a classroom environmental data-processing framework for collecting and analyzing learning context, illumination settings, environmental data, and students' performance data was introduced. This framework can help researchers explore the correlation between student performance and environmental parameter

Chun hsien chen, published on 14 November 2020- Virtual reality (VR) has been applied in many different sectors, including manufacturing and engineering industries as well as in the healthcare industry where VR-equipped health products can provide better prevention, rehabilitation, and palliative care in a user-friendly environment. The smart product-service system (PSS) aims to achieve better user experience and higher user satisfaction. Limited research has been conducted on the benefits of leveraging advanced VR systems in a sustainable smart PSS via analysis of human factors. Moreover, existing VR research lacks the systematic methods that fully consider user performance and experience in a smart manner. This study aims to outline a conceptual approach for user-centric development of value-added smart PSSs based on VR, and to develop a case study with a smart VR rowing machine to illustrate the proposed approach and to verify its feasibility and effectiveness. After the VR platform is created, usergenerated and VR system-generated data are collected and processed. The value-added services of VR-assisted user experience and real-time data feedback can be achieved. The results of this ergonomic experiment were determined by jointly considering the user-generated and VR systemgenerated data. They showed that the developed smart VR rowing machine significantly enhanced the user experience. The value-added services of VR- assisted user experience and real-time data feedback have been achieved. Theoretically, the proposed conceptual framework for a VR-assisted, user-centric, smart PSS provides an approach of specific data-driven and value-added services compared to traditional methods since it simultaneously considers user-generated and VR systemgenerated data. In the practical smart PSS design of VR products, this paper contributes to the design methodology of VR products and value-added services to obtain more accurate and objective user experience. It is hoped that this study can offer insightful guidance to enterprises that are involved in the process of creating the value-added design and service based on VR.

Dongsu Kim, Published on 10 June 2022- The building sector is one of the largest contributors to the world's total energy use and greenhouse gas emissions. Advancements in building energy technologies have played a critical role in enhancing the energy sustainability of the built environment. Extensive research and new techniques in energy and environmental systems for buildings have recently emerged to address the global challenges. This study reviews existing articles in the literature, mostly since 2000, to explore technological advancement in building energy and environmental systems that can be applied to smart homes and buildings. This review study focuses on an overview of the design and implementation of energy-related smart building technologies, including energy management systems, renewable energy applications, and current advanced smart technologies for optimal function and energy-efficient performance. To review the advancement in building energy-related technologies, a systematic review process is adopted based on available published reviews and research types of articles. Review-type articles are first assessed to explore the current literature on the relevant keywords and to capture major research scopes. Research-type papers are then examined to investigate associated keywords and work scopes, including objectives, focuses, limitations, and future needs. Throughout the comprehensive literature review, this study identifies various techniques of smart home/building applications that have provided detailed solutions or guidelines in different applications to enhance the quality of people's daily activities and the sustainability of the built environmental system. This paper shows trends in human activities and technology advancements in digital solutions with energy management systems and practical designs. Understanding the overall energy flow between a building and its environmentally connected systems is also important for future buildings and community levels. This paper assists in understanding the pathway toward future smart homes/buildings and their technologies for researchers in related research field.

Ela Tekkaya Poursani,published on february 2013 -Smart Technology in the Field of Interior Design t. This paper has two main objectives. The first objective is to present a set of design projects of interior design students focused on distributed, ambient and ubiquitous interactions. In this context, student works are analyzed under a theoretical framework. The second objective is to introduce the field of interior design as one of the forthcoming parties in smart technology implications. Interior design is a multi-faceted profession in which creative and technical solutions are applied to achieve a built interior environment. These solutions involve

functionality, enhancement of the quality of life and the culture of the occupants and aesthetics. Interior design includes a scope of services to protect and enhance the health, life safety and welfare of the public. The paper analyzes and discusses nine design projects of the Topics Studio at the Interior Design Program, College of Architecture, University of Texas at San Antonio. In the 2012 Spring Semester, interior design students have applied an intense research pairing healthcare design strategies and smart technologies to two self-directed design thesis projects: A residence for Alzheimer's Disease patient, and a healthcare clinic for medical professionals who treat patients including Alzheimer's Disease. Projects are designed through the research and hypothetical application of remote control technologies, automation technologies, monitoring technologies, prompting / reminding technologies and prediction technologies. Physical and cognitive impairments, ADL limitations of older adults and patients, difficulties faced by family members and caregivers and clinical interventions in community health are considered not only from the interior design standpoint but also through technological advances. Results of this paper discuss how advanced technology is used as a design element by interior design students and merged with patient, caregiver and physician needs triad of healthcare projects. Perspectives on the studio experience are emphasized for future integrated design and practices of smart technology and interior design.

Imam Santosa, Published on 2020-11-30 -Many lecture space facilities today are included in audism category because they do not yet have space design regulations for hearing disabilities. As a result, students with hearing disabilities, who are not identified from the start, require more time to sustain their education. This study aims to apply related theories including DeafSpace principles and interiority to find lecture space settings that can support the behavior of SHD's. Lecture spaces in the CADL-BIT building are not currently designed specifically for users with disabilities in application of interiority. This research used a qualitative method with a case study approach. Data is collected through observation, simulation, and interviews to explore the experience of space users. The research results showed that spatial experience was influenced by behavior, activities and space. The behavior of students with hearing disabilities in lecture space settings is influenced by interiority. There are lecture classrooms found to form of interiority, which are u-shaped furniture settings, easy visibility to read facial expressions and lips movements, and can interact with each other, bright lighting (not dim), wall colors according to pastel colors, plain wall material, and acoustics are used sound absorbers. This research is expected to be beneficial for scholarship about the DeafSpace design, community, and building based on social culture.

Jin HUANG1,published on November 2018- With the development of virtual reality (VR) and human computer interaction technology, how to use natural and efficient interaction methods in the virtual environment has become a hot topic of research. Gesture is one of the most important communication methods of human beings, which can effectively express users' demands. In the past few decades, gesture-based interaction has made significant progress. This article focuses on the gesture interaction technology and discusses the definition and classification of gestures, input devices for gesture interaction, and gesture interaction recognition technology. The application of gesture interaction technology in virtual reality is studied, the existing problems in the current gesture interaction are summarized, and the future development is prospected.

Lian Loke,published on 17th may 2014- Touch-based interactions with computing technologies have become commonplace in the last few years, from mobile phones to tabletop surfaces. The sense of touch however is not limited to the hand; the entire skin surface of the body is available for tactile interaction. In architecture, researchers are now investigating the potential of interactive surfaces for future architectonic elements, such as walls, floors and ceilings. Apart from the traditional focus on the visual and spatial design considerations of such elements, tactile interaction with interactive surfaces is of growing interest. We present an interactive folded surface as a prototype of future interactive architectural surfaces. We explain how physiological understandings of touch and tactile interaction informed the design choices of the prototype. Our work contributes to understandings of how the material properties and interactive behaviours of these new surfaces will afford new kinds of human experience centred on the sense of touch.

Lei Xie, published on 2023 -The continuous development of human civilization and the continuous progress of science and technology have played a decisive role in the evolution of the human living environment, and the continuous improvement of the human living environment and the increasing development of human production technology have jointly promoted the emergence and development of "smart home". The popularization and application of smart homes in interior design is imperative. From the perspective of interior design under the background of the "Internet +" era, this article first defines the meaning and types of smart

homes, analyzes the reasons for the rapid development of smart homes, and then analyzes the relationship between smart homes and interior design, and reveals the problem of applying smart home in interior design, and finally provides suggestions for the integration of smart home and interior design from the perspective of human settlement environment design.

Lukas Smirek, published on 2016 -In the last few years substantial progress has been made in smart home technologies, and promises to support and assist us in our daily life are higher than ever. This holds not only for regular users but also for people with special needs such as the elderly and people with disabilities. The appropriate design of smart homes can enable a more independent life for these users and can give them the chance to stay in their familiar environment for a longer period of time. Hence, the smart home concept can play an important role when addressing the demographic change that is present in most industrial countries. However, although technologies seem to be advanced and the expected benefits are high, a wide-spread adoption has not yet taken place. There are various reasons for this situation. Among them, the lack of appropriate user interfaces for the heterogeneous user group of future smart homes and the problem of low interoperability between different smart home systems can be mentioned. Two platforms addressing these problems are the Eclipse Smart Home (ESH) project and the Universal Remote Console (URC). ESH focuses on the integration of different device and back-end technologies; URC provides a personalized, pluggable user interface. This paper analyzes the similarities and differences between the two systems. As a result of the analysis, a concept for integrating the ideas of URC into the ESH project is proposed. This concept is a first step towards a platform for personalized user interfaces in the Smart Home and Ambient Assisted Living domain.

Marzieh Allahdadi, published on September 2016- Disability, as a social and biological phenomenon, is a reality that faced by all communities notwithstanding their extent of development including industrial and other states. Disabled people as citizens have rights that must be noted. Moreover, providing inhabitants with relative welfare through services and facilities is one of the main reasons of formation of cities. Based on the principle of flexibility and simple and equal use that is one of universal principles of designing, easy and unhindered access for disabled people is seemed inevitable when designing and conditioning urban equipment and furniture. This in turn will result in facilitated use of that equipment and furniture by the elderly, children, and those who with baby stroller and things. There are limited facilities

devised for this class of society and noting this problem seems more essential than ever. Thus, we have attempted here to investigate problems associated to quality of urban equipment and furniture in Vanak Street in Tehran using a descriptive- analytical method. This street is highly crowded and several trading and administrative centers have been located here. The, we have provided recommendations regarding appropriate designing to improve that equipment and furniture.

Nico surantha,published on 2018- This research aims to design and implement a home security system with the capability for human detection. The traditional home security system, i.e. closed circuit television (CCTV) can only capture and record the video without able to give warning feedback if there is any suspicious object. Therefore, an additional object detection and warning method is required if there is an intruder. The proposed design is implemented using Raspberry Pi 3 and Arduino, which are connected by USB cable. The PIR sensor is installed on the Arduino and the webcam is mounted on Raspberry Pi 3. The Raspberry Pi 3 is used to process inputs from received sensors and process images for human detection. The PIR sensor detects the movement around the sensor to activate the webcam to capture a picture. Then, the object recognition is performed using histogram of gradient (HoG) and support vector machine (SVM) to detect the suspicious object. If the suspicious object is detected, then alarm is activated to warn the house owner about the existence of intruder. The evaluation results show that it takes in average 2 seconds for proposed system to detect the intruder. It also shows that the system can successfully detects the intruder with accuracy of 89%.

Omarkar bhat,published on December 2017- The Internet of Things (IoT) is the network of physical objects, devices, vehicles, buildings and other items which are embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data. IoT has many potential applications and can be implemented in fields like home automation, offering several features like economical use of energy to protection and safety. This section illustrates detailed working of IoT based security systems and Energy efficient devices. This topic aims at controlling home appliances via Smartphone using Wi-Fi as communication protocol. It provides information regarding various hardware and software components required for implementing the same. It shows us how the IoT will touch our life in near future.

Rafika Rizky Ramadhani, Published on Nov, 30th 2022- The building sector absorbs 40% of

global energy sources. Energy demand in the building sector is dominated by around 60 – 70% electricity, mainly used for air conditioning, water pumping machines, and lighting. On average, artificial lighting can consume 37% of the total electrical energy needs. Meanwhile, sunlight enters the room through the morning window from noon until the afternoon. Using unnecessary or excessive room lighting when there is a natural light source in the room consumes a relatively large total energy requirement of the building. There is a need for a smart lighting system specifically for indoors for efficient energy management and a lighting control system integrated with IoT, which utilizes the intensity of natural light in a room. In this paper, we proposed that the Smart Room Lighting System uses the fuzzy logic method based on ESP32 to control the lighting in the room to save electricity usage for a room lamp. The result of the tool's design, it can control the light starting from bright, dim, and lights go out. The results obtained by the Smart Room Lighting System can reduce power consumption by up to 93% and energy by up to 70%.

Raz kamaran radha,published on 9 may 2021- Most Smart home literature is not realistic since technologies are implemented at the end of the design process without taking into account the working, physical, and spatial aspects. No comprehensive work has been done regarding spatial design modifications accommodating the lifestyle requirement of Smart Home inhabitants, especially in Sulaymaniyah, Iraq. To fill the knowledge gap the research establishes practical guidelines for designing- Flexible Smart Home Models based on holistic literature review and case study of design preferences using virtual reality experiment and a questionnaire survey. Results indicated higher technology acceptance and flexible spatial integration of public and private zones by younger sample (75 m^2 prototype) compared to the older sample with 115 m^2 prototype and less versatile space. It was concluded that the opportunity to change scale, form, relation, and configuration becomes simpler, quicker with more possibilities of arranging spaces in smart homes with the help of the hypothetical prototypes.

Shaheena Noor, published on 2023 – This research project aims to design and develop a 3D interior designing application to provide a virtual experience to users in which they can visualize a standard home (sample space) and do interior designing. Users can interact with four main interior design modules i.e., Furniture, Tiles, Paints and Customization (Mix and Match). Users will be able to experience it on two different platforms, which are the desktop and the VR version. Its primary purpose is to display interior design products with complete context,

unlike stores where small samples are displayed. This will help customers to make a better buying decision when it comes to design and decorate their homes.

Wei Liu, published on October 2021-With the development of society and the continuous advancement of technology, people's research on smart home products is gradually deepening. Compared with the past, smart homes are no longer out of reach, but actually penetrate into our lives. However, while continuously exploring the technology of smart home products, designers have not conducted in-depth research on the interactive mode of the control interface of smart home products. Based on this, the purpose of this article is to study the smart home interior design based on intelligent three-dimensional virtual technology. This article first analyzes the development and current situation of smart homes, and on this basis, combines three-dimensional virtual reality technology to research and analyze smart home systems (S H S). This article systematically elaborates the design of functional modules of the S H S based on intelligent 3D virtual reality technology and the method of converting 2D plane to 3D space coordinate. And use comparative analysis method, interview method and other research methods to carry out experimental research on the theme of this article. The research shows that compared with the traditional S H S, the S H S based on 3D virtual technology studied in this paper has higher feasibility.

Yaman Sokiena, published on November 2023-This research aims to advance the Understanding of the integration of Internet of Things (IoT) systems in interior design and the built environment. To assess the current state of research in this field, a systematic review method was used. Multiple databases were searched using keywords such as "smart homes," "smart houses," "IoT and interior design," "IoT," and "the built environment," yielding 475 articles. Following the application of inclusion criteria, 14 articles were chosen for analysis. The findings of this review indicate that, while IoT system integration in the built environment is still in its preliminary stages, it has significant potential for global development in the future. By investigating current and future approaches to IoT systems in interior design and the built environment, the paper adds to the body of knowledge.

CHAPTER 3

MATERIALS & METHODOLOGY

The method was based on the rules for assessing the level of a working smart home environment, functions comfort and safety, general recommendations, how to calculate intermediate indicators, how to form a scale, and how to calculate the final result. First,these rules and suggestions were used to develop the method.Then, using the AI models,the approach evaluated the level of comfort and safety and all aspects that may be engaged.To ensure smart home rules and adequate assessment levels are the best and most effective,it is crucial to evaluate the quality of the working environment. There are several guidelines or suggestions for determining the functional domain of a smart home, namely objectively assessing compatibility and interoperability.The compatibility and interoperability across various systems and devices are crucial factors to consider while analyzing a smart home's operational environment. When testing deep levels of connectivity, it is essential to evaluate how connected the home is.To assess the degree of automation and control in the home, it is vital to check the automation and control systems that are critical components of smart homes. Considering the security situation is very important for smart homes.Hence, assessing the amount of security the residence provides is essential. Another crucial aspect of intelligent houses is energy efficiency. A smart home should be customized to the owner's unique requirements and preferences. Finally, the usability of smart home technologies must be evaluated. These guidelines can quantify the quality of an intelligent,good living space and point out opportunities for enhancement and improvement

IMAGE 3.1

3.1 NEW RULES FOR THE ENHANCED SMART HOME

The user will need many rules for several devices to create smart behaviors in smart homes. In addition, the user may need more time or technical knowledge to develop good device control practices. An innovative home system can automate the tedious task of rule creation using machine learning. Machine learning solutions can find patterns in data from smart home devices and automatically create rules to control the connected devices.The specifications of the system's features and capabilities and the relevant regulatory framework will determine the rules and regulations for determining the operational level of an upgraded smart home environment. A thorough assessment should consider the criteria above to ensure that the smart home environment is risk-free, secure, and simple for people to use. In addition, the following important considerations must be respected:

• Even nontechnical people should be able to utilize and navigate the user interface easily. Moreover, people with disabilities such as hearing or vision impairments should be able to use the interface without difficulty.

• Smart sensors and automation should be included in the system's design to decrease energy waste and maximize energy consumption.

• Innovative home settings should be able to operate seamlessly with various hardware and software, including third-party apps.

• To avoid data loss or system failures, the system has to be dependable, robust, and equipped with backup and recovery features.

Although cutting-edge home automation systems are becoming increasingly common,there is still a need to investigate the concerns preventing their widespread adoption. For example, further study is required to determine what factors influence user adoption, such as perceived utility, convenience, and privacy concerns . Regarding some of the essential gaps in smart home research, which vary depending on the topic and area of focus, such as interoperability and how to improve interoperability and create a more seamless smart home experience for users, security and privacy, where it is needed to develop adequate protection and privacy measures to protect users and their data, etc., this article attempts to create a set of rules for the objective of integrating AI models in intelligent homes. Pleasant human–machine interaction is necessary to enhance the connection between humans and machines by increasing the accuracy of speech recognition systems and a need to drastically reduce energy usage through an energy efficiency procedure

3.2 AI AND SMART HOME INTERACTION

The term “artificial intelligence” (AI) refers to the process of recreating human in tellect in computers by teaching them to learn and reason in the same way that humans do . Problem solving, decision making, and pattern identification are all examples of activities that fall under this. AI technology appeared in the early 2000s when the term “smart building” was trendy. Still, it only reflected the level of performance of building automation systems, not having a direct bearing on its “intelligence”. Today, we can already talk about optimizing the functioning of building engineering systems based on offline data analysis achieved through AI. The system implements automated building functions, covering a broad set of home functions for inhabitants. For example, the change in the Sun’s position during the day can be considered when controlling lighting, curtains, heating, and air conditioning. The operation of ventilation systems can be based not only on sensors signals of the presence of CO2 but also on the occupancy schedules of specific premises, cleaning, and sanitation, which is especially relevant in recent times. This proactive building management can be applied to almost any system, reducing energy con sumption and operating costs, increasing space efficiency, and more. Intelligent assistants are among today’s smart homes’ most crucial artificial intelligence applications. These virtual assistants can be controlled by voice commands and perform various functions.Some examples include playing music, making reminders, and managing other smart devices in the home.

• Control of a Smart Home Through the Use of a Touch Control Panel Controlling a smart home via a touch control panel is one of the most straightforward methods. The touch panel With the help of this display, it is possible to activate all the essential communication systems

and program their functioning. Figure 3.1-The smart home control system.

IMAGE 3.2

3.3 UBIQUITOUS COMPUTING

This alludes to numerous information technologies that enable the integration of computing and communication capabilities across consumer electronics. Mobile phones,home appliances, and other daily goods are examples of such gadgets (dishes, furniture, etc.).Many new terms, including "smart environment" with "smart objects", "ambient intelligence"(enveloping intelligence), "pervasive computing" (sensing computing), "proactivecomputing" (active computing), "intelligent space", etc., have recently emerged because of the deeper integration of various social applications and networking services into our daily lives. For example, "ambient intelligence" refers to a system's primary objective of assisting a person in everyday tasks.

3.4 ENVIRONMENT-SMART TECHNOLOGY

A "smart environment" with "smart objects" is, in general, an information system made up of a wireless sensor network, a server for centralized data collection and control, a network of "smart objects" with built-in intelligent systems, and a collection of mobile devices to the system that provide a user interface with built-in services. Sensors include temperature, light, touch, proximity, video sensors (microvideo cameras), and sound sensors fitted on furniture. Simple objects with intelligence can be utilized as "smart objects". These academic fields are all relatively autonomous. Innovative sensor technologies are used in lifestyle, healthcare, fitness, manufacturing, and everyday life for various purposes. Due to the robustness of the wireless connection, they have been simultaneously incorporated into the central control system of the smart home. Thanks to their sensors, they can provide information on their state and other things. Examples of the behavior of smart objects are as follows:

• When the user asks, "Where is my x?" the bookmark, tied to a cabinet with items in the living or bedroom, responds, "I'm here", and the LED blinks.The local light and the computer on the desk switch on when a person sits in a chair in front of it. The system controls the lighting in the space or the amount of fresh air necessary for a particular room with a function by the state guidelines while keeping track of the number of people present. A person's preferred music or television channel is activated if they visit a space for leisure around lunchtime.The light intensity and hue will vary once the system analyzes the room user's facialexpression to determine their feelings. If a person lies down on an intelligent bed, it will automatically dim the light, turn on the local light if the person picks up a book to read (turning off the TV), detect the body's position on the bed, turn it over, and, using this information and the sound of breathing, determine whether the person is sleeping or not.

Merging neural networks and expert systems in a hybrid approach is the most promising method for structuring an intellectual environment. Moreover, it offers the ability to formulate understanding at a certain level in a straightforward manner conducive to perception (both for entering the system and for deriving knowledge to explain or debug the plan)—the fact that artificial neural networks are the most closely related to natural mechanisms for data processing and knowledge acquisition explains their prospects in comparison with other methods of representing and processing knowledge.

3.5 ENVIRONMENT- SMART ARCHITECTURE

A wireless sensor network, intelligent devices, and a server constitute the foundation of the information system that supports the intellectual environment. A design such as this enables the integration of electrical circuits with free-form plastic sensor housing in situations where managing home functions and quality of life calls for complete monitoring systems with user-friendly features The most straightforward sensors, such as tactile signals indicating whether a person has sat in a chair or if a door is closed and microvideo cameras, which may function as a distributed technological vision system, are connected to the touch wireless network. Several noncontact sensor technologies include motion, pressure, video, object contact, and sound sensors. In addition, smart and multicomponent technologies (combinations of ambient and wearable sensors) were found. Doors, windows, furniture, courts, and books may all be wired into the wireless network of intelligent things, including lights, home appliances, mobile robots, cell phones and standard personal computers. Remember that although these two networks are one wireless LAN physically, they might vary logically. Activity recognition, glory recognition and honor recognition of people and objects are three critical functions of the recognition subsystem. However, apart from utilizing data from conventional sensors, these systems cannot offer automated activity detection due to a lack of contextual knowledge.

Figure 3.2- Structure of the information system of the smart environment

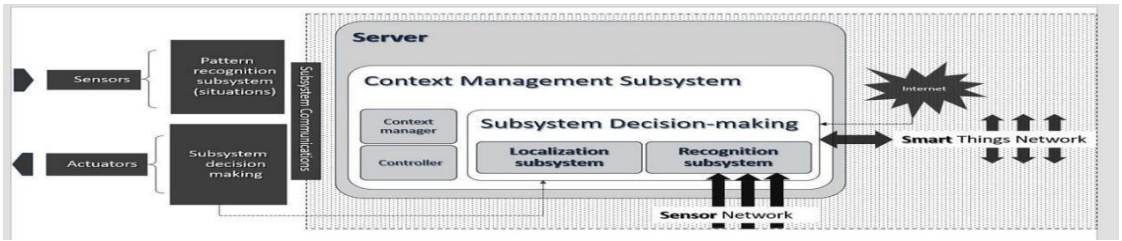

IMAGE 3.3

The system uses neural networks, probabilistic models, and a hybrid approach with knowledge-based decision making. The localization subsystem must use information from numerous local

sources, such as visual input from many cameras, to establish the positions of objects and people. The system can locate itself in an unfamiliar area and create a scene map,which we can be used to track and find the locations of essential things worldwide . The application of neural-network-proposed coordinate recognition by the vector of the intensity of signals (electromagnetic or ultrasonic) from many beacons helps locate the problem. The context management subsystem gathers, archives, and up dates the text the decision-making subsystem utilizes. The context of circumstances iden tified and actions conducted relates to the time, location, problem-solving task, solution state, and other critical components. The system, in which all the services and jobs solved by the system are incorporated, includes the decision-making subsystem. In contrast to other subsystems, which are frequently built as middleware, this subsys tem is generally regarded as application software. This subsystem implements interaction with the user through sensors (or input devices) and actuators of intelligent objects, such as cell phones, personal computers, or robots. Applications that carry out tasks, including de vice control, control over a multimedia device, item search, communication, cheering up loneliness, and question-and-answer systems, maybe a part of this subsystem.Consider personal matters, a reminder of business, ensuring the home is secure, keeping an eye on the child's position, and work, as well as offering aid to visually im paired people with orientation challenges. Many of these applications include a question and-answer system for locating accurate information, and a technique for tracking a kid's contact when contacting the homeowner who has lost a child is essential. A hardware and software board is integrated into an intelligent device to enable communication with other intelligent objects and the perception of significant external events or states through sen sors and actuators. It is necessary to use a smart environment server via a wireless net work. The number of devices linked to the Internet has substantially expanded during the past few years. Through various sensors that perceive reality by digitizing some critical criteria of interest, these gadgets may communicate with humans and the outside world, gathering vast amounts of data.

The hybrid expert system architecture shown below can build a decision-making subsystem on a server or as a component of an intelligent item. In this case, a built-in hybrid expert system is suggested to produce the "intelligence" of smart objects.

3.6 EXPERT SYSTEM AND NEURAL NETWORK COMMUNICATION

Many significant advances have been made in the design of knowledge-based intelligent systems (KBIS), most notably expert systems. These advances may be categorized into one of many direct modeling techniques. In the knowledge base, a neural network is characterized as a frame-

like source data structure that describes the parameters for choosing how the expert system will interact with other sources of information and communicate with the user. Consider the following scenario: the logic inference interpreter finds a specific frame in the rule's executed condition. In such a scenario, the system stops and utilizes the socket to submit a request for the relevant fact to another software (a neural network). The process of interpreting the rule continues once the truth has been ascertained.

The neural network results may be understood using logical reasoning with a straightforward logical output, the neural network may provide precise information while pinpointing a specific thing or situation.. Symbolic representations, such as words or phrases, are created from the vector signals from the neural network using a dictionary. For example, the dictionary may include the following terms: item, kitchen cabinet, a package of chips, bowl, bottle, window, parallel-pipped,complicated shape (for the dispersed position/state of a person), condition, standing, lying and sitting (for the recognized form or for a recognized object). Furthermore, the verified fact has previously been received from the neural network and is already in the database of facts. In that case, it is utilized without the neural network's request until its obsolescence period has passed.

The suggested hybrid expert system's knowledge representation and utilization levels are depicted

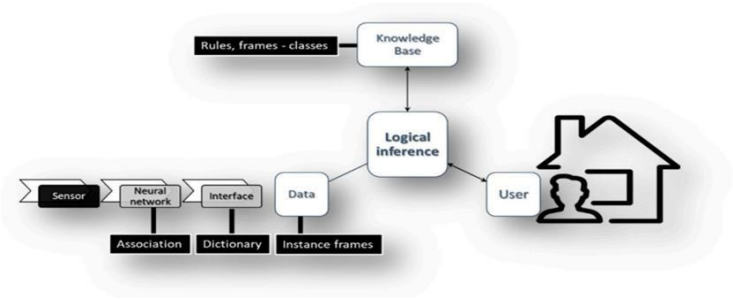

IMAGE 3.4

CHAPTER 4

CASE STUDY

4.1 CASE STUDY 1:CAPITAL TOWER,SINGAPORE

Year : 2000

Architect:RSP architects planners & Engineers

Owner:Capital land Group

Location:Tanjong Pagar,Singapore

IMAGE 4.1

Capital Tower is the fourth-largest building in Singapore. Owned by CapitaLand Group, it has become a distinctive presence in the skyline of the city state's financial district. In addition to CapitaLand, the building houses financial services firms and the exclusive private members China Club.It was built with a host of smart features introduced to improve occupant experience. It also boasts impressive green credentials, with technology designed to make it more energy efficient, sustainable and eco-friendly.

Motion detectors in the lift lobby and toilets measure room occupancy to ensure energy is only used when people are in the room. Low emissivity double-glazed glass windows reduce heat penetration and minimise energy consumption The building uses condensation from the air handling unit to reduce water usage Devices to monitor carbon dioxide and carbon monoxide are installed in the car park and office spaces to ensure optimal air quality throughout the building. The car park guidance system monitors parking spaces in real time, and displays

availability to drivers, as well as directing them to empty spaces Smart elevators with dual LCE panels placed to display live news and stock market updates.

4.2 CASE STUDY 2:BURJ KHALIFA,UAE

Year:2010

Architect:Skidmore,Owings & Merrill LLP

Owner:Emaar Properties

Location:Dubai,UAE

IMAGE 4.2

One of the most famous buildings in the world, the Burj Khalifa is not only a towering icon of human progress and the growing wealth of the gulf states but also a global leader in smart building technology.Occupied by hotels, corporate suites and luxury apartments, the sheer size of the building requires elaborate cleaning, plumbing and air conditioning systems that leverage innovative smart technologies

The building automation system (BMS) relays real-time information to an IoT platform, which uses smart algorithms to identify anomalies and maintenance issues; this lets facilities improve building maintenance and asset reliability; FMs have reduced total maintenance hours by 40% since launching the system.The system delivers a unified view of building systems and increases the connectivity of smart devices, letting FMs improve efficiency, increase responsiveness and maximise operational control. Recycling systems use gravity to discharge

water from the plumbing fixtures, floor drains, mechanical equipment and storm water into the city's sewer system The air conditioning system draws cooler and fresher air from the upper floors to the ground floors; condensation is collected via a collection system and used to irrigate nearby parkland Unmanned cleaning machines clean the top 27 floors of windows and the glass spire.

The Honeywell Smart Building Score Awards programme, developed by Honeywell, a Fortune 100 global technology and Internet of Things (IoT) pioneer, assessed the smartness of buildings across the region based on three key indicators how green, safe and productive they are.

CONCLUSION

AI models in smart home design can improve usability and convenience. In this case study, artificial intelligence (AI) technology in smart home systems enhances energy efficiency, user experience, and security. Smart homes will undoubtedly improve as AI technology advances and become more affordable. AI models can assist designers in creating smart homes that meet the needs of residents and improve their quality of life. When we talk about a "smart" home, we usually mean a place where people can feel safe, have a pleasant experience, and use their resources efficiently. While the term smart home may suggest otherwise today, intelligent room control was not initially included in the design process (from English, the word smart, in this case, is understood as designing and developing as convenient). Instead, priority profiles or manual control are used to manage the system. Because of advancements in artificial intelligence and increased functionality of equipment and systems, "intelligent" room management is now possible and more practicable than ever. This is how the system works. In other words, a "smart home" is a "thinking building" that can adapt to its surroundings and take appropriate action. Architects and designers have to integrate the technical solutions within smart home components in a friendly manner, beginning with the design phase and based on the users' needs. This will allow the AEC sector to improve and design competent home functions during the design process. They have to ensure four factors:

- It should be possible to incorporate numerous tools, sensors, and processes into the house's technical and intelligent system during project design.
- While designing the home system, security should come first.
- The home system should be expandable and versatile to include future technological innovations.

• The user should be considered while designing the home systems. Therefore, they should be easy to use and intuitive.

Conclusions and practical recommendations for designing and developing buildings to improve creative home design are drawn from this analysis of how artificial intelligence models have been used, focusing on how the interoperability and compatibility of smart home devices can be improved.This article helps readers understand cutting-edge home technology for boosting smart home features in modern building design by classifying the many types of smart homes already in use and the goals they seek to accomplish. It also highlights the conveniences homeowners may look forward to as a result of using this technology.

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