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# Framework Analysis of Smart House based on Orange Technology use Systematic Literature

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**Abstract**
*Nowadays, the home environment remains largely unsupportive for elderly individuals, many of whom require assistance in their daily lives. Challenges related to safety, health, happiness, and independence often lead to social isolation. According to population projections from 2017, there were 23.66 million elderly people in Indonesia, a number expected to reach 27.08 million by 2020. Despite the growing elderly population, most smart home technologies still focus on comfort and convenience for the general adult population, without specifically addressing the unique needs of older adults. As a result, many elderly individuals are relocated to nursing homes, causing further separation from their families and diminishing their quality of life. Orange Technology is an interdisciplinary approach that integrates technology to enhance happiness, care, and health, particularly for the elderly. This study conducted a literature review of 54 selected articles from scientific databases, including IEEE Xplore, ACM Digital Library, and ProQuest, published between 2002 and 2017. The results of this review propose a smart home framework for elderly care based on orange technology, consisting of seven key components: sensors, monitoring systems, wireless connectivity, scalability, low cost, GPS, and ease of installation and maintenance.*

**Keywords**: *Smart house, Framework, Systematic Literature Review, Analysis of House*
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## I. INTRODUCTION

Orange technology is an interdisciplinary research field that integrates technological innovation with health sciences, psychological well-being, and human care (Betz et al., 2023), (Grasso-Cladera et al., 2025). The scope of this field spans computer science, electrical engineering, biomedical engineering, psychology, physiology, cognitive science, communication, economics, and the social sciences (Bibri, 2023), (Li et al., 2022). The term "orange technology" is inspired by the symbolic meaning of two colors: red, which represents vitality, health, and happiness; and yellow, which signifies warmth and care. Together, these colors illustrate the core vision of orange technology (Betz et al., 2023), (Li et al., 2022). The main objective of orange technology is to enhance human well-being by fostering health, happiness, and care through technological support that promotes a harmonious relationship between individuals and their environment.

In order to improve and secure human living environments—referred to as "homes"—it is necessary to develop technological solutions in parallel with the principles of orange computing. This approach is particularly relevant for supporting specific population groups, such as the elderly. Therefore, orange technology should be integrated with smart technologies to enhance the quality of life and independence of older adults (Stara et al., 2023), (Li et al., 2022).

The smart home concept is increasingly recognized as an essential solution to improving home-based care for the elderly (Vrančić et al., 2024), (Facchinetti et al., 2023). Smart homes offer older adults the opportunity to remain in their residences without relying on continuous assistance. These systems can provide daily support, safety monitoring, and personalized services that cater to their specific needs (Damaševičius et al., 2023).

According to Government Regulation No. 43 of 2020, an elderly person is defined as someone aged 60 years or older (Almohaisen et al., 2022), (Qin et al., 2022). The proportion of the elderly population is increasing rapidly in both developed and developing countries. This demographic shift is primarily driven by declining fertility and mortality rates, alongside increasing life expectancy, all of which significantly impact the overall population structure (Cisma et al., 2022). Population aging is influenced by multiple factors, such as improved nutrition, sanitation, healthcare services, as well as advances in education and socio-economic development (Grigoroiu et al., 2025), (Amoadu et al., 2024).

Based on population projections, the number of elderly people in Indonesia was estimated at 50.66 million in 2023. However, this number is projected to slightly decrease to 48.19 million by 2035 (Almohaisen et al., 2022), (Qin et al., 2022). A country is considered to have an aging population structure when more than seven percent of its population is classified as elderly (Soeweno). As of 2024, the elderly population in Indonesia has reached 12.03% of the total population.

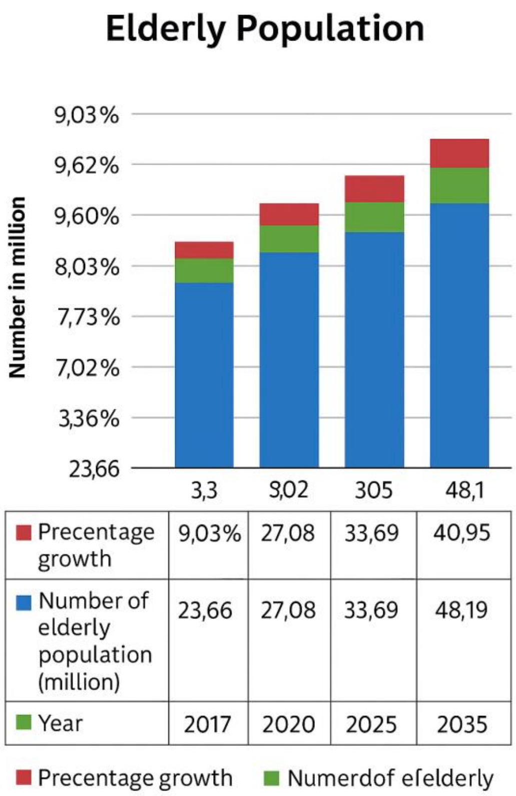


**Figure 1. Growth of the Elderly Population (***Source: Central Bureau of Statistics, SUSENAS 2023)*

Smart homes are residential environments specifically designed to enhance human life through interactive technologies and non-intrusive support systems. These systems aim to support independence, assist with daily activities, and improve overall well-being without requiring constant assistance from others (Cisma et al., 2022), (Grigoroiu et al., 2025). The development of smart homes involves multiple interdisciplinary elements, including technology, engineering, ergonomics, management, communication, social care, and safety (Amoadu et al., 2024).

Accordingly, this study seeks to explore: What components are necessary in smart homes that adopt the principles of orange technology for elderly populations? The results of this investigation are expected to contribute to the development of a smart home framework that is not only suitable for the general population but also optimized to support comfort, independence, and improved quality of life for older adults. In this way, the concept of orange technology offers a path toward greater prosperity and autonomy for the elderly.

## II. LITERATURE REVIEW

### *A. Orange Technology*

According to (Grigoroiu et al., 2025), orange technology incorporates considerations such as carbon footprints in technological applications, alongside metrics designed to assess health, happiness, and compassionate care. These characteristics serve as evaluative indicators for both individuals and technological products. The orange technology model can be decomposed into three fundamental dimensions: health, happiness, and care, as illustrated in Figure 2.

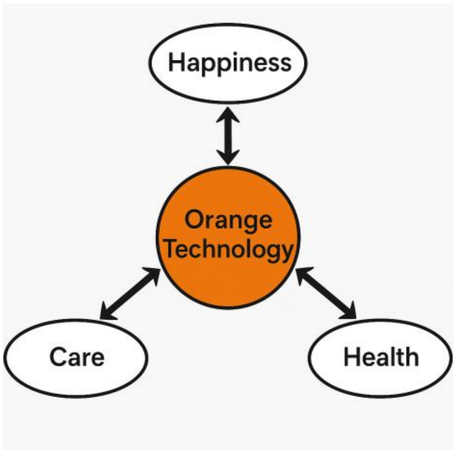


**Figure 2.** Characteristics of Orange Technology *(Source: (Ziyae, 2016))*

At its core, orange technology seeks to enhance human well-being through the use of socially oriented technological innovations, with a particular emphasis on promoting happiness and care, especially for the elderly (Amoadu et al., 2024). Issues concerning the elderly and their interaction with the environment have become increasingly significant, necessitating innovative solutions (Haluza & Jungwirth, 2023). In this context, orange technology also offers recommendations for system designs tailored specifically for elderly users (Lu et al., 2024).

Orange technology comprises both physical and non-physical components. The physical components typically include sensors, GPS modules, and wireless communication devices. In contrast, the non-physical components encompass features such as scalability, remote monitoring, low cost, ease of installation, and minimal maintenance requirements. The overarching goal of healthcare for the elderly is to support independence (Miura et al., 2022), provide comfort (Kumar et al., 2023), and facilitate enhanced communication (Cantone et al., 2023) through assistive technologies. These two categories of components—physical and non-physical—are intended to work synergistically to improve the overall quality of life for elderly individuals (Pilar et al., 2025).

In this discussion, we propose a smart home development model designed to monitor elderly individuals and promote their autonomy (Almusaed et al., 2023). This system integrates artificial intelligence (AI) (Chen et al., 2024), multi-sensor technologies (Kush, 2025), and a comprehensive analysis of user needs and behavioral patterns (Kumar et al., 2022). A range of sensors can be installed within the home environment to measure various parameters, such as indoor temperature (Bourdeau et al., 2023), track the entry and exit of visitors (Yun et al., 2024), assess lighting conditions (Shokrollahi et al., 2024), and monitor energy consumption (Elkabalawy et al., 2024). These devices are connected to a central computing system capable of analyzing multi-sensor data to identify daily habits and routines (Chromik et al., 2022).

### *B. Elements of Orange Technology*

This review identifies three core elements of orange technology: care, happiness, and health. Based on the analysis of the reviewed literature, the element of care appears in 26 papers, while happiness is discussed in 15 papers, and health in 13 papers. Data related to the distribution of these elements in the literature can be found in Table 1.

**Table 1.** Elements of Orange Technology

| Element | Number of Papers | References |
|---|---|---|
| Happiness | 15 | (Damaševičius et al., 2023); (Cisma et al., 2022); (Cantone et al., 2023); (Pilar et al., 2025); (Kumar et al., 2022); (Yun et al., 2024); (Elkabalawy et al., 2024); (Oladinrin et al., 2023); (Hung, 2023); (Giannone et al., 2023); (Papageorgiou & Simitzis, 2022); (Aspiotis et al., 2022); (Jim et al., 2024); (Ahsan et al., 2024), (Kush, 2025) |
| Health | 13 | (Grasso-Cladera et al., 2025); (Li et al., 2022); (Miura et al., 2022); (Almusaed et al., 2023); (Bourdeau et al., 2023); (Shokrollahi et al., 2024); (Olivelli et al., 2024); (Ianculescu et al., 2025); (Coman et al., 2024) |
| Care | 26 | (Betz et al., 2023); (Stara et al., 2023); (Vrančić et al., 2024); (Facchinetti et al., 2023); (Almohaisen et al., 2022); (Qin et al., 2022); (Grigoroiu et al., 2025); (Amoadu et al., 2024).; (Haluza & Jungwirth, 2023); (Lu et al., 2024); (Kumar et al., 2023); (Chen et al., 2024); (Chromik et al., 2022); (Taye, 2023); (Lopes et al., 2023); (Farouk et al., 2023); (Yang et al., 2023); (Kerman et al., 2024); (Cascella et al., 2023); (Lee & Chiu, 2022); (Su & Yang, 2023); (Lv et al., 2022); (Schobel et al., 2025); (Tsihrintzis et al., 2022); (Zhou et al., 2024); (Ellahi et al., 2024); (Nhep et al., 2024); (Li et al., 2024); (Mobasseri et al., 2025); (De Donder & Stegen, 2024) |

#### *1. Happiness*

In the context of people or products, the element of happiness can be measured through various indicators. For instance, electrical sensors can detect and record expressions such as laughter and smiling (Damaševičius et al., 2023), (Cisma et al., 2022). Emotional states may also be assessed through physiological markers, such as the presence of dopamine, as individuals interact with products, enabling researchers to trace "happiness footprints" (Cantone et al., 2023), (Pilar et al., 2025), (Kumar et al., 2022). These experiences can be captured via sensing equipment (Yun et al., 2024) or through self-report methods like questionnaires (Elkabalawy et al., 2024). Other indicators include body temperature fluctuations as an emotional response (Giannone et al., 2023), (Papageorgiou & Simitzis, 2022), (Papageorgiou & Simitzis, 2022), (Aspiotis et al., 2022).

All of these data points are then integrated to assess the individual's level of happiness, although this remains a complex and nuanced challenge (Jim et al., 2024), (Ahsan et al., 2024).

2. *Health*

The health element refers to indicators related to both individuals and products. It includes the detection of toxic substances in products or biological outputs from the human body (Grasso-Cladera et al., 2025), (Li et al., 2022), (Miura et al., 2022), (Almusaed et al., 2023). In most cases, health-related systems are integrated with expert medical inputs, where a system can consult with physicians or health professionals (Bourdeau et al., 2023), (Shokrollahi et al., 2024), (Olivelli et al., 2024), (Ianculescu et al., 2025). The collected data are compiled into a knowledge database that enables the system to respond with health recommendations tailored to user needs (Coman et al., 2024). This creates a feedback loop that ensures personalized and relevant healthcare support.

3. *Care*

The element of care in orange technology emphasizes the human-centered transformation of any design into one that incorporates health, happiness, and care as fundamental criteria. To qualify as an "orange" solution, a product or system must meet a certain threshold across these three elements. The "care" aspect often involves warming treatment, a concept that highlights compassionate and responsive interaction (Betz et al., 2023), (Stara et al., 2023), (Vrančić et al., 2024), (Facchinetti et al., 2023), (Almohaisen et al., 2022), (Qin et al., 2022), (Grigoroiu et al., 2025), (Amoadu et al., 2024), (Haluza & Jungwirth, 2023), (Lu et al., 2024), (Kumar et al., 2023), (Chen et al., 2024), (Chromik et al., 2022).

One of the central challenges in this element is understanding who the user is (Taye, 2023), (Cascella et al., 2023), (Lopes et al., 2023), how they receive timely responses (Farouk et al., 2023), (Yang et al., 2023), (Kerman et al., 2024), (Cascella et al., 2023), (Lee & Chiu, 2022), (Su & Yang, 2023), and when such responses should occur to ensure effectiveness. Therefore, systems must incorporate semantic understanding and be supported by accurate Human–Computer Interaction (HCI) mechanisms (Lv et al., 2022), (Schobel et al., 2025), (Tsihrintzis et al., 2022), (Zhou et al., 2024).

Practical examples of the care element include systems facilitating charitable donations (Ellahi et al., 2024), services provided by social workers (Nhep et al., 2024), and support structures such as retirement homes (Li et al., 2024), (Mobasseri et al., 2025), (De Donder & Stegen, 2024). These implementations demonstrate the real-world application of care-oriented technology for social welfare.

## III. RESEARCH METHOD

This study was conducted through a comprehensive literature review of previous research on orange technology applied in smart homes, specifically aimed at designing frameworks for elderly people (Almohaisen et al., 2022), (Qin et al., 2022). The review process involved defining relevant keywords, applying inclusion and exclusion criteria, extracting data, and analyzing findings to answer the research questions (Yun et al., 2024).

### A. *Literature Search Process*

The first step was to identify appropriate sources for relevant articles and documents. The databases selected for this systematic literature review included ACM Digital Library, AIS

Electronic Library, Emerald Insight, IEEE Xplore Digital Library, ScienceDirect, ProQuest, NCBI, SpringerLink, and Taylor & Francis Online.

### *B. Inclusion and Exclusion Criteria*

The literature selection process consisted of three stages: Studies Found, Candidate Studies, and Selected Studies. Initially, a search across these ten scientific databases yielded 2,377 papers relevant to smart home components for elderly people within the context of orange computing. After removing duplicate entries, 386 unique papers remained. Then, 289 papers were excluded based on irrelevant titles, leaving 97 papers for abstract screening. Finally, 54 papers were selected for detailed review to answer the research questions.

To ensure the validity and relevance of the literature, several exclusion criteria were applied. Only publications dated between 2002 and 2018 were considered. Additionally, only completed papers that included full details, such as journal or conference information and author identities, were included. Duplicate studies were omitted to avoid redundancy.

### *C. Data Extraction*

From the 386 initially screened papers, 97 candidate studies were selected based on relevance to the title and research objectives. After further investigation, 54 papers met all criteria and were included in the final review for this study.

## IV. RESULT AND DISCUSSION

### *A. Respondent Characteristics*

This study aims to investigate the components of Orange Technology in smart homes designed for elderly individuals. Based on a review of 54 documents, a smart home framework utilizing Orange Technology was found to consist of seven key components: scalability, low cost, sensors, monitoring, wireless communication, GPS, and installation and maintenance facilities. These components collectively support the health, safety, and independence of elderly users. For analytical clarity, these seven components are conceptually grouped into two overarching categories: Wearable Units, which refer to physical, user-operated technologies, and Non-Physical Units, which cover environmental systems, infrastructural support, and operational aspects of the smart home. Subsequent sections, including the proposed framework and sensor implementation, elaborate on how these categories function within the integrated smart home system.

#### *1. Wearable Unit*

The Wearable Unit refers to technology that can be worn or directly used by elderly individuals within the home environment. It integrates three major technological aspects: sensors, wireless communication, and GPS, each playing a crucial role in monitoring, assisting, and protecting elderly users. The most critical element of the wearable unit is the sensor system. Sensors are implemented in smart homes to monitor user activity, detect health or safety risks, and support automated services. Environmental sensors are commonly embedded in household items such as beds, chairs, or kitchen utensils to detect interactions between the elderly and their surroundings, thereby helping to recognize daily activity patterns. In addition to embedded sensors, wearable motion sensors such as bracelets or tags are often employed. These use technologies like infrared, microwave, or acoustic detection to track movement and are generally unobtrusive, allowing users to go about their routines without disruption.

These sensors typically operate within a wireless network, enabling real-time monitoring and seamless data transmission. Wireless motion detectors are often combined with magnetic contact sensors on doors and windows to monitor movement patterns, detect presence, and identify unusual behaviors such as wandering or prolonged inactivity. This system can issue alerts to caregivers in case of emergencies, and is usually installed across all rooms for comprehensive coverage.

Additionally, GPS technology enhances the functionality of wearable units by enabling location tracking and supporting home automation. Elderly users interact with GPS-enabled systems to operate automatic kitchen appliances, lighting, door locks, temperature regulators, and security features. These smart devices help reduce physical burden and prevent household accidents. When these devices are used by elderly individuals, user-friendly and accessible interfaces are essential to ensure ease of operation.

In summary, the integration of sensors, wireless communication, and GPS in wearable units plays a vital role in enabling smart homes to provide continuous monitoring, enhance safety, and promote independent living for elderly residents.

2. *Non-Physical Unit*

Non-physical components refer to intangible yet essential elements that support the functionality and sustainability of smart homes for the elderly. These include monitoring, scalability, affordability (low cost), and ease of installation and maintenance. These components play a significant role in ensuring that elderly individuals experience a safe, healthy, and happy living environment within their own homes.

One key non-physical component is scalability, which refers to the adaptability and flexibility of the smart home system. It allows the system to be adjusted based on the user's physical and cognitive conditions (Betz et al., 2023), (Cisma et al., 2022), (Pilar et al., 2025). For elderly individuals, scalable systems enable the gradual integration of new features as needs evolve, helping them carry out daily activities more effectively (Yun et al., 2024), (Elkabalawy et al., 2024), (Coman et al., 2024), (Ahsan et al., 2024).

Monitoring is another critical aspect of the non-physical unit. Smart homes are equipped with systems that can remotely monitor environmental conditions such as room temperature, humidity, and air quality, including smoke detection (Grasso-Cladera et al., 2025), (Almusaed et al., 2023), (Bourdeau et al., 2023), (Shokrollahi et al., 2024). More importantly, these systems are capable of monitoring vital signs and physiological conditions, such as heart rate, blood pressure, oxygen levels, and physical activity (Olivelli et al., 2024), (Lopes et al., 2023), (Farouk et al., 2023), (Kerman et al., 2024). This real-time health tracking can be accessed remotely by caregivers or family members, allowing timely intervention and assistance when needed (Nhep et al., 2024).

Another important consideration is cost-efficiency. Smart home technologies should be developed and implemented at a low cost (Damaševičius et al., 2023), (Cantone et al., 2023), (Kumar et al., 2022), enabling elderly individuals to access these innovations without relying on expensive healthcare facilities. Affordable smart home systems contribute significantly to the well-being and comfort of aging individuals, particularly those on limited incomes (Oladinrin et al., 2023), (Hung, 2023), (Giannone et al., 2023).

Lastly, ease of installation and maintenance is a vital component to ensure the sustainability of the system. Smart home devices should be easy to install, maintain, and repair as needed (Bibri, 2023), (Miura et al., 2022), (Ianculescu et al., 2025). Systems must be designed to minimize complexity and technical barriers, making them accessible and functional for elderly users. Regular maintenance should be simple, ensuring long-term usability and alignment with the objectives of Orange Technology—to provide a safe, healthy, independent, and dignified living experience for the elderly (Papageorgiou & Simitzis, 2022), (Aspiotis et al., 2022), (Jim et al., 2024).

## *3. Framework Analysis*

Based on the literature review, a proposed framework for smart home components using Orange Technology is divided into two main units: the Wearable Unit and the Non-Physical Unit. The Wearable Unit consists of components such as sensors, wireless communication, and GPS. These technologies collect real-time data on the movement, location, and physiological activities of elderly users. Information gathered from the wearable devices is processed through a home gateway system. This gateway performs pre-processing and indoor localization using a centralized database, followed by activity recognition algorithms that interpret the data. The processed physiological and contextual information is then transmitted securely to a private web platform, enabling both local and remote access.

The Non-Physical Unit, on the other hand, involves the interpretation and application of data collected by wearable devices. Monitoring systems use this data to provide continuous observation of environmental and physiological conditions inside the house. Scalability features help assess daily health progress and support tailored intervention strategies. However, a common constraint is the affordability of such technologies, many of which remain inaccessible to those who need them most. Therefore, low-cost solutions are crucial to making these systems usable by the intended population. In addition, ease of maintenance remains a non-negligible factor, as the reliability of the smart home depends on devices being easy to repair and sustain.

In summary, the integration of wearable and non-physical components is essential for building a comprehensive smart home system based on Orange Technology. Together, these components aim to promote happiness, independence, and health for elderly individuals living in smart environments, as shown in Figure 3.

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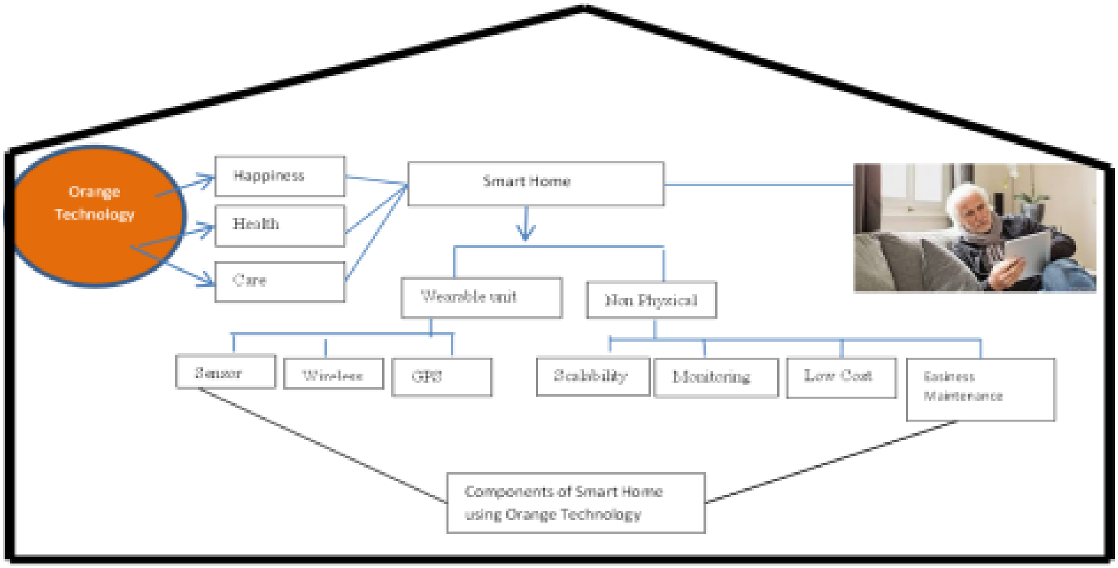


**Figure 3**. Framework Analysis of Component Smart House on Orange Technology *(Source: Result of Research, 2025)*

4. *Proposed Sensor for Smart House*

The proposed sensor system for a smart house designed for elderly residents integrates electronic and electrical appliances with sensors placed strategically in each room, as illustrated in Figure 4. These components are interconnected to enable continuous monitoring of the occupants' activities and to support daily living safely and efficiently.

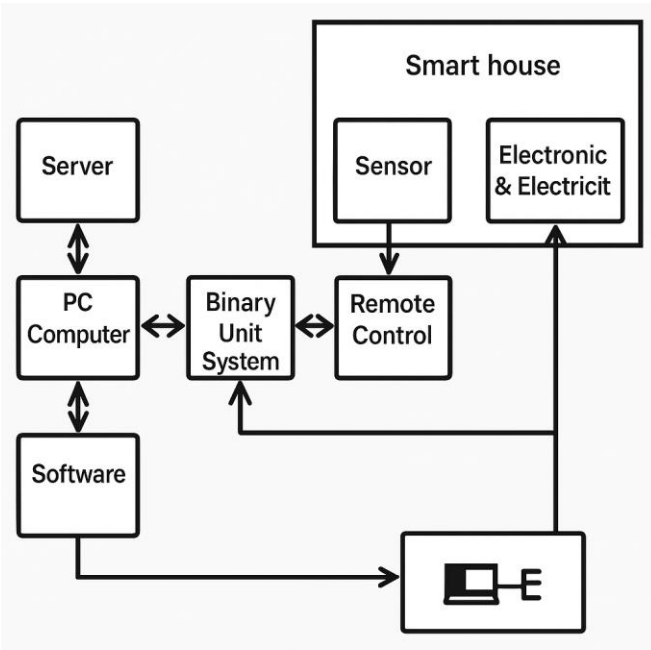


**Figure 4.** Proposed Sensor for Smart House *(Source: Result of research, 2025)*

Each electronic and electrical device is connected to a centralized remote control system, while the installed sensors are linked to a control panel operating under a binary unit system. This control panel serves as the interface between the sensors and a personal computer (PC), allowing real-time communication and data processing. The monitoring equipment consists of a PC that includes a monitor and keyboard. This PC functions as a server that stores a database containing patterns of regular behavior and daily routines typically performed by the elderly occupants. The control panel shown in Figure 4 acts as the central point for managing this data and coordinating system operations. Furthermore, the PC records all activities that take place within the household, providing a comprehensive overview of the occupants' behavior. Dedicated software is used to monitor habitual activities, support decision-making processes, and assist in diagnosing abnormal conditions. In addition, the PC acts as the primary interface for supervising and interacting with the elderly occupants through the interconnected network of sensors and appliances.

## V. CONCLUSION AND RECOMMENDATION

This study concludes that the development of smart homes for the elderly should incorporate seven essential components derived from the concept of orange technology: scalability, affordability, sensor integration, monitoring capabilities, wireless communication, GPS functionality, and ease of installation and maintenance. These components are not only technologically significant but also align with the principles of health, comfort, and human-centered design. The study offers both theoretical and practical implications. Theoretically, it reinforces the importance of integrating technological innovation with holistic care principles, emphasizing the interaction between humans, their environments, and smart systems. Practically, the findings suggest that smart housing should aim to enhance comfort, independence, safety, and quality of life for older adults. By designing living environments that anticipate their needs, this research contributes to sustainable aging in place.

One of the limitations of this study lies in the scope and timeframe of the literature reviewed. Ideally, literature reviews should focus on research published within the past five years to reflect the most recent advancements. However, due to the limited number of recent studies specifically addressing orange technology in smart housing for the elderly, this research includes publications from up to sixteen years ago. As such, while the conceptual framework remains valuable, some elements may no longer reflect current technological standards. Future research is recommended to empirically validate the proposed components of smart housing through case studies or experimental implementation. Additionally, there is a need to explore the integration of therapeutic features, adaptive interfaces, and personalized health monitoring systems within the smart home environment. These future directions may further strengthen the role of smart housing in supporting the physical, emotional, and cognitive well-being of elderly individuals.

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