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## SYSREMACIC REVIEW ARTICLE

### Ontologies for Smart Homes in Elderly Healthcare: A Systematic Review Najme Nazeri<sup>1</sup>, Atefeh Sharif<sup>\*2</sup>, Mohammad Hassanzadeh<sup>3</sup>

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#### ABSTRACT

In the near future, many elderly people will live alone, either by necessity or choice, requiring support from families and governments to maintain their health and quality of life. The senior population will represent a significant portion of the smart home market, benefiting from its technology, though its full potential won't be realized without proper design. Ontology can play a key role in this by organizing knowledge about entities, interactions, and qualities, which helps manage knowledge flow and reduces complexity in the smart home sector. Many ontologies have already been developed in this area. Studying ontologies' dimensions and comprehending their maturation curve and potential future directions are our objectives in this paper. We looked at 48 papers on the ontology of smart homes for elderly health in this systematic review. Keywords included elderly health, ontology, and smart home, which were examined in both healthcare and technology domains. PubMed, IEEE, Medline, Google Scholar, and Scopus databases were selected for the search, and two researchers reviewed all articles according to the inclusion and exclusion criteria. Ontologies are essential for generating, processing, and using health data, as well as advancing personalized care and medicine. By analyzing and comparing various ontologies, we identified future trends like precision medicine, tactile Internet, and feedback systems. We classified ontologies into three generations and found that recent ones include new dimensions such as nutrition, cognitive and mental health, social behavior, physiological status, and physical activity. ©authors.

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## 1. Introduction

The population of Iran has reportedly reached 83 million people, with the elderly population over 60 years old making up 8 million 231 thousand people, or roughly 9.9% of the population, and the population over 65 making up 6.4% of the population, according to a report posted on the website of the Ministry of Health and citing the country's Statistics Organization in 2019. The old population in Iran has grown at a pace of 3.62 percent over the past two to three decades, which is about three times faster than Iran's general population growth rate of 1.24 percent. According to projections, the proportion of the senior population will surpass 10% in 2021, 19.4% in 2041, and 26.1% in 2051, which indicates that more than a quarter of the nation's citizens will be elderly. Compared to the world, the proportion of the population over 65 years old was about 9% in 2019 and is predicted to increase to 16% by 2050. It is observed that the rate of increase in the elderly population in Iran is higher than in the world.

The topic of aging will rise to the top of the national agenda in the ensuing decades, based on the aforementioned facts and projections as well as the rising life expectancy and longevity brought on by bettering health care. It is especially crucial to prepare for the predicted situation and manage it properly.

Many elderly people will live alone in the coming years, either out of necessity or choice, and will need help from their families and the government to manage and maintain their health and quality of life. Smartening and remote care are the first solutions that can be used in light of technological advancement and the decline in the active workforce ratio. The development of smart houses and their adoption by the elderly is one of these technologies. Smart home technology gathers data on visitors and shares it with family members as well as primary care providers. An environment where the equipment's capabilities are automated and the devices are connected is what is meant by the term "smart home," according to another definition. Because of their high vulnerability, the

elderly currently presents a significant challenge to governments and the majority of families. The situation can be dangerous due to the statistic of 1 in 3 elderly people (Azadi & Bastami, 2021). Older people most frequently get injuries from falling at home because their environment is unsuitable for their needs, according to studies of hospital admissions. Burns from fires (often caused by failing to put out a fire) and drug poisoning are the other two home harm causes for older individuals.

IoT applications will proliferate across a variety of industries due to the quick development of technology. On the other hand, a sea of data will be in front of us, and each of the aforementioned devices will greatly contribute to its creation by their specific objectives. This pool is filled with massive amounts of big data produced by sensors and IoT devices, providing an excellent opportunity to use this data for tactical and strategic decisions (Moubadi, 2018). Health monitoring is one of the potential uses for data on the conditions of those residing in the house. Context awareness is one of the most important issues with pervasive computing. The smart house, a special instance of pervasive computing, has allowed every family to take advantage of living in a high-tech home today (Van Nguyen, Lim, Nguyen, Choi, & Lee, 2010). With the development of smart services and the advancement of smart home support infrastructure, it will be possible to use natural language instructions to simplify and improve our lives.

The smart home concept model has been implemented to personalize and develop these services more effectively (Y. Chen, Liu, Huang, Hu, & Chen, 2019). Although conceptual models do a good job of expressing knowledge items, they lack relationships. A kind of semantic relationship is discovered when the user, activity, and contextual information are connected in the home environment. Ontology can therefore be used to represent these relationships so that semantic information can be deduced (Van

Nguyen et al., 2010). Technology is always improving, which raises living standards and makes life easier for people. Many of these advancements are aimed at healthcare systems, with a particular emphasis in recent years on assisting elderly people to maintain their independence in their homes. Data is collected continuously from various sensors and is used for contextual anomaly detection. As a result, the amount of sensor contextual data grows exponentially. However, the lack of syntactic or semantic integrity constrained these sensor data's ability to be shared, reused, and interpreted (Nabli, Regaig, Djemaa, & Sliman, 2022). Globally, smart home technology has advanced significantly in recent years, and its use is growing. However, despite the large capacity described, little knowledge is processed and retrieved from them, and these enormous sources of data are being lost since the significance of data and the application of knowledge have been disregarded.

Right now is the best time to create the ideal ontologies and models for creating smart homes that are tailored to the needs of certain customers. To monitor and manage health conditions, it is also the ideal moment to increase the knowledge value of the data that can be acquired through this technology. Beings that are conceptually tied to one another makeup existence. These relationships create a network of ideas that depicts the totality of existence. The philosophical idea of ontology was initially exploited by artificial intelligence in fields including knowledge engineering, natural language processing, and knowledge representation. The most widely used definition of ontology in the fields of information science and epistemology is Gruber's, which views ontology as the recognized definition of conceptualization (morady, ghaebi, & kamran, 2021). Ontology is generally regarded as the study of what is real in the world of philosophy. An ontology in information technology is a model of the operation of entities and their interaction in certain knowledge or practice domains. Ontology is "the concept of conceptualization

used to let programs and humans share information," according to Tom Gruber (Gruber, 1993). The definition of classes and properties of entities, as well as the connections or similarities between classes, the hierarchical relationship between properties, or the connections between classes and properties related to constraint, cooperation, equivalence, differentiation, transition, or describe the symmetry of classes and properties, can all be found in ontologies. This rational and unambiguous image also makes it possible to infer new information from already known information (Kim & Choi, 2006). An explicit formal articulation of a common understanding is ontology. An invaluable tool for navigating the complexity of intelligence and the demand for transdisciplinary knowledge, ontology is a conceptual model of a portion of reality that incorporates interrelated concepts about a particular field of application (De Nicola & Villani, 2021).

Knowledge processing can effectively analyze data generated by Internet of Things (IoT) sensors in smart home environments for elderly healthcare. With the use of appropriate ontologies, this data can play a vital role in optimal information management, timely diagnosis of diseases, and provision of personalized treatment recommendations. (Kalijehdouz & Tahmatan, 2025)

Role of ontologies in data management: Ontologies help organize and classify information by defining concepts and relationships between data. In the context of healthcare, ontologies can help integrate different data from different sources, such as biosensors and wearable devices, and enable fast and effective access to medical information.

Role of ontologies in disease diagnosis: By analyzing data collected by sensors and applying knowledge processing algorithms, patterns associated with specific medical conditions can be identified. This process helps in early diagnosis of diseases and providing preventive care for the elderly.

**Role of Ontologies in Treatment Recommendations:** Using analytical data and medical ontologies, systems can provide personalized treatment recommendations. These recommendations can include suggestions for medications, lifestyle changes, and other medical interventions that help improve the quality of life of the elderly.

By utilizing knowledge processing and appropriate ontologies, it can help improve the quality of healthcare for the elderly in smart home environments. (Srivastava et al., 2023)

Analysis of data obtained from biological and environmental sensors can help improve decision-making processes in healthcare. This data is processed using machine learning and deep learning algorithms to help identify patterns and predict health events.

**Biosensor and Environmental Data Analysis:**

- **Data Collection and Preprocessing:** Data collected from wearable sensors, such as heart rate, respiratory, and optical sensors, are stored in a database after filtering and preparation to prepare for further analysis.
- **Feature Extraction:** Using deep learning algorithms, effective features are extracted from the acquired signals to be used to predict health events.
- **Modeling and Prediction:** By applying machine learning and deep learning models, such as LSTM and DBN neural networks, predictions about health events can be made and help in timely decision-making. (Bukharaini et al., 2023)

## 2. Literature Review

An ontological model based on the environment was introduced in a paper written in 2006. The smart home ontology was created using the OWL (Web Ontology Language), and data and metadata were recognized in it. To test whether the created program can recognize the user's waking condition based on light sensor data, bedroom TV status, etc. and organize the wake-up

According to the previously mentioned statistics-based predictions, a major portion of the smart home market will be geared toward the older population in the next years, who will profit from this technology's capabilities but will be far from its optimal state without adequate design. On the other hand, one of the primary priorities of the healthcare system will be keeping an eye on the health and care of people who wish to live independently or would ineluctably find themselves in such a scenario. As was indicated before, using intelligent technologies and producing knowledge from the gathered data requires the development of an information system and conceptual framework. Ignoring it could result in the failure of crucial objectives including system integrity, accurate inference, and support for quick decision-making.

Aging is a multifactorial physiological process, and the development of new IoT systems, tools and devices, specifically targeted at older people, should be based on a comprehensive framework based on strong scientific knowledge in different health domains. In addition, interoperability should be ensured using standard frameworks or approaches. These aspects are still largely lacking in the specific literature (Mastropietro et al., 2021). In this area, ontology can be useful as a modern, effective tool. Ontologies will greatly aid in managing the gathering, storing, creation, and flow of knowledge by generating knowledge about dimensions, entities, attributes, and relationships while minimizing the complexity of the multidisciplinary space of process intelligence.

settings, the scenario of waking up was performed in this work as an example utilizing the Jena computer design software (Kim & Choi, 2006).

An ontological approach to administering smart home remote care (TSH) for the elderly who have lost their cognitive independence was proposed in a 2007 article which used Protege2000 to develop a modular design in OWL. This study's major goal was to fully characterize the domain using ontology to

offer a solid foundation for the creation, setup, and use of software applications (Latfi, Lefebvre, & Descheneaux, 2007). This study's approach is the most similar to the current design, with the exception that it was created exclusively for an elderly population and the model's effectiveness was not assessed. Due to the variety of house surroundings, equipment, and people, smart home applications must be adaptable and flexible.

An ontology-based framework was suggested in a paper that was presented in 2009 at the International Conference on Embedded Software and Systems as an alternative to planning for every household to automate the integration of the necessary apps. Depending on the equipment available in each particular household, this system automatically provides the relevant services. In addition, it dynamically modifies the environment's parameters to take into account the resources that are accessible and the customer's wants. Customers can differentiate themselves by altering their typical behavior patterns thanks to the provision for custom performance template customization. This paper introduces the SOC framework to allow the identification of semantic links among smart home device types (Xu et al., 2009).

A novel method for context-based knowledge management in the smart sector was introduced in a paper in 2010. Devices in a smart space can communicate with one another and exchange data and services. Knowledge management in these systems enables the coordination of several institutional functions in a smart area. A knowledge structure and relationships model was proposed in this study using an ontological approach to context-based knowledge management in intelligent space. Knowledge resources are located in the lower layer, while the knowledge map is described in the upper layer. The appropriate action is chosen in the top layer based on the scenario and context, and feedback is delivered to the desired tool or saved in the user profile (Smirnov, Shilov, & Kashevnik, 2010).

An ontology-based smart home system was introduced by Nagoyan et al. in 2010. They gathered background data from a variety of sources, including base explosion problems, devices, agents, sensors, ontology administration, and ontology search. Environmental information was mentioned as a problem in achieving the underlying ontological base (Van Nguyen et al., 2010).

A network of embedded items that can perceive, interact, and communicate is known as the Internet of Things (IoT). Daily growth in the number of linked devices makes it possible to create a wide range of applications for the Internet of Things. IoT has been approached in a variety of methods up until this point, including non-IP solutions, IP-based solutions, and more recently, high-end solutions known as firmware. In recent research, the issue of sensor diversity, data complexity, and heterogeneity has been resolved by utilizing ontology.

The smart home sensor ontology, a customized ontology based on the ontology of semantic sensor networks, is presented in a paper written by Caesar et al. in 2015 (SSNs). The authors built a simulation environment for a smart home case using their ontology, and they provided early performance findings. The sensors were divided into categories for temperature, lighting, appliances, and security.

A rudimentary type of ontology was created in this study using the Protege program and contains sensors, objects, units, observations, physical entities, attributes, commands, and infrastructure, in accordance with the focus of the writers of this paper on hardware and infrastructure. In order to evaluate the performance of applications and ontologies, many situations with various hardware were taken into consideration. This shown that the results are not independent of hardware and operating system (Sezer, Can, & Dogdu, 2015).

To address smart home entities varied and bulky data, Tao et al. proposed semantic management and application of ontology-based data in 2017. The smart home system model, collected from users' home actions,

was used to create a general ontology model containing correlation ideas and a semantic fusion model. User behavior analysis and a semantic matching rule were used to create ontology-based semantic inference for accurate and tailored home services. An inference testing system was then used to demonstrate that user behavior was appropriately recognized and inference was correctly conducted. The algorithm predicts each family member's behavior, such as what drink he would consume, based on his preferences (Tao, Ota, & Dong, 2017). The IoT architecture of the smart home care plan delivers common and transparent information to IoT devices, end users, relatives, health professionals, caregivers, and organizations. This study uses ontology to integrate measurable data from different sources to evaluate events semantically and contextually. The system's activity detection is tested in a smart home. Thus, the developed ontology may describe data at various abstraction levels and support inference and decision-making. This research indicates that data volume does not affect inference time. Today's commercial solutions provide sensor infrastructure but lack context awareness (Alirezaie et al., 2017). Some definitions perceive the context's information as knowledge, which can result in inference and decision-making when necessary.

At the 17th International Semantic Web Conference in 2018, a publication introduced the smart environment ontology model, which uses semantic sensor network ontology. Sensor network ontology is used to illustrate intelligent and sensor environments by describing sensors, their observations, and related ideas. This article discusses smart home care strategies after presenting smart environment ontology. This project uses sensors, actuators, and the Internet to help the elderly live independently. Smart home care requires semantic interaction to link sensor data with patient background information to give a variety of services. These services contain patient status, event reason, and the system's next steps. Background information might be patient-generated health reports,

informal patient caregivers, or home care services, primary care centers, or hospital data in the electronic health record (EHR). The variability of services, devices, and communication technologies makes applying standard IoT technology to ICT-supported senior services difficult. For instance, the home care system should alert the senior caregiver if their heart rate rises without apparent cause, such as exercise. The system analyzes high heart rates based on the user's health (gender, age, health history, etc.) and present condition using semantic linkages (rest or active exercise, etc.) (Alirezaie, Hammar, Blomqvist, Nyström, & Ivanova, 2018). A 2021 study examined health monitoring using sensors, wearable sensors, and social media platforms that enable continuous patient monitoring and the generation of significant amounts

of health data. Social media health data is also vast and unstructured. The study found that healthcare monitoring systems struggle to capture and analyze sensor and social network data. Traditional machine learning methods cannot predict anomalies in massive healthcare data. Thus, a new cloud-based healthcare monitoring framework and a huge data analysis engine for reliable healthcare data storage and analysis and increased classification accuracy are proposed. Two-way data mining, ontology, and short-term-long-term memory procedures underpin the big data analysis engine. Data mining efficiently preprocesses healthcare data and reduces dimensions. The proposed ontology provides semantic knowledge about institutions and their interactions with diabetes and hypertension. Bilateral short-term and long-term memory properly classifies healthcare data to forecast drug side effects and abnormalities in patients. The suggested system categorizes patients' health status using diabetes, blood pressure, mental health, and medication review data. Protégé Web Ontology Language with Java produced this framework. The approach accurately handles heterogeneous data and enhances health status classification and drug side effect prediction (Ali et al., 2021).

Some studies with an ontology view for the healthcare of the elderly, along with their most important results, are given in Table 1.

*Table 1. Recent study's techniques and results*

Paper	Insights	Methods Used	Results
Karagiorgou (2018)	The ontology-driven semantic interoperability agent showed robust accuracy in monitoring elderly people's activities, mobility patterns, and providing accurate recommendations for mobilization at home.	Ontology-driven approach Semantic interoperability agent for personalized recommendations	Agent provides personalized incentives for elderly people home mobilization. Agent accurately classifies activities and gives accurate mobilization recommendations.
Ganesan, Paul, & Seo (2022)	The accuracy of elderly people monitoring was improved to 99.81% in training and 99.78% in testing using a smart Human Activity Recognition system with advanced machine learning algorithms.	K-means++ clustering to identify outliers Ensemble classification techniques using stacking and bagging classifiers	Best classification accuracy achieved: 99.81% Ensemble classification techniques (stacking and bagging classifiers) used.
Sondes, Elhadj, & Chaari (2019)	The ontology-based healthcare monitoring system in the Internet of Things showed feasibility and efficiency in semantic querying, indicating promising accuracy for monitoring elderly people.	Ontology integration Semantic querying validation	Feasibility and efficiency of proposed ontology validated. Capability to grow into specialized ontology for health monitoring shown.
Nabli (2022)	The paper develops a Context and Quality of Context (CQoC) ontology for accurate monitoring of elderly people, ensuring safety and early issue alerts in a health monitoring system.	Development of CQoC ontology for handling contextual data. Creation of SQoCHMS for elderly health monitoring and alerts.	Developed CQoC ontology for handling contextual data and interpretation. Created SQoCHMS for elderly safety with early issue alerts.
Zulfiqar (2022)	The elderly monitoring ontology in the study showed 100% sensitivity for geriatric risks with satisfactory positive and negative predictive values, indicating high accuracy in detecting health deterioration.	MyPredi platform uses medical sensors for real-time feedback analysis. Alerts generated based on physiological information and medical ontology analysis.	6,073 measurements made, averaging 253 per day 110 alerts issued, with 15 mild, 31 moderate, and 64 severe
Bajenaru, Dobre, Ciobanu, & Balog (2019)		Patient profile design using ontologies Personalized support for daily/medical activities in vINCI care	Personalized assistance services for older adults in IoT-based ecosystem. Patient profile used for personalized support in daily/medical activities.
Basori (2020)	The deep learning algorithm achieved 76% accuracy in monitoring heart failure / disease in elderly using wearable IoT devices, showing potential for further improvement with suitable data sets.	Wearable IoT devices attached to patient's cloth for monitoring. Deep learning analysis for heart failure detection with 76% accuracy.	Deep learning analysis for heart failure with 76% accuracy. System sends alerts in emergency states for elderly monitoring.
Paraschiakos et al. (2020)	The accuracy of elderly people monitoring ontology reached over 93% by merging different walking paces, enhancing activity recognition in wearable sensor data.	Random Forest AR models with varying sensor set-ups LARA algorithm for activity granularity in predictions	Best model accuracy >85% with additional physiological information. 7-class model optimal for accuracy and granularity in free-living data.

In this section, we provide a comparative analysis of several studies related to ontologies in e-health, the Internet of Things (IoT), and their application to smart homes, particularly focusing on elderly health. The aim is to highlight the strengths and weaknesses of the approaches used in each study, categorizing them by their methodology or focus, and identifying gaps in the literature that justify further research.

**Ontology-based Approach for Healthy Lifestyle Management:** (A. Chatterjee, A. Prinz, M. Gerdes, & S. Martinez, 2021)

Chatterjee et al. conducted a literature review to examine the use of ontologies in three domains: e-health, IoT, and medicine, with a particular focus on how they support healthy lifestyle management. The authors present a systematic approach to organizing data for health monitoring through the use of ontologies.

**Strengths:** This study offers a clear categorization of ontologies in e-health, IoT, and medicine, offering valuable insights into their interrelations and potential applications for health management. It highlights the importance of ontologies for logical data representation, making complex health data more accessible and interpretable.

**Weaknesses:** The study's focus on general e-health applications overlooks more specific areas, such as smart homes and elderly care. Additionally, it does not delve deeply into the limitations of current ontology-based systems, particularly in real-time health monitoring for aging populations.

***Machine and Cognitive Intelligence for Human Health:*** (X. Chen et al., 2022)

This study provides a thorough analysis of how Web intelligence and AI can be applied to health, with a focus on ontology mining, machine learning algorithms (e.g., support vector machines and convolutional neural networks), and their potential in disease detection, monitoring, and diagnosis.

**Strengths:** The study offers a comprehensive review of various AI technologies in healthcare, highlighting the potential of ontologies in supporting clinical outcomes and enhancing informatics-enabled brain research. It also covers a wide range of applications, from clinical text mining to disease diagnosis.

**Weaknesses:** While the study emphasizes AI's potential in healthcare, it is heavily focused on algorithmic advancements and less on the practical challenges of implementing these technologies in real-world settings, particularly for the elderly in smart homes. There is also a lack of discussion regarding the scalability and integration of these systems into existing healthcare infrastructures.

***Innovative Assisted Living Aids and Remote Monitoring for Aging Societies:*** (Sapci & Sapci, 2019)

This review analyzes studies on remote monitoring technologies, AI-driven solutions, and robotic systems for elderly care. The focus is on how technological advancements, like home telemonitoring,

have the potential to reduce readmissions and improve the quality of care for aging individuals.

**Strengths:** The study provides an extensive review of assistive technologies and their impact on elderly care, offering valuable insights into how telecare and smart home systems can improve health outcomes. The use of multiple databases ensures a broad coverage of relevant literature.

**Weaknesses:** A significant limitation identified in the review is the lack of critical appraisal in many of the included studies. This weakens the reliability of the findings and limits the generalizability of the conclusions. Furthermore, while the study identifies key technological themes (e.g., robotics, AI), it does not provide a detailed comparison of these technologies or discuss their practical challenges in implementation, particularly for older adults with varying health conditions.

***Human Activity Model for Smart Homes:*** (Ni, Pau de la Cruz, & Garcia Hernando, 2016)

Ni et al. propose a human activity model based on ontologies, divided into three categories: user ontologies, smart home context ontologies, and activities of daily living (ADL) ontologies. This model is designed to support user, context, and activity modeling in smart homes.

**Strengths:** The study provides a structured approach to activity modeling in smart homes, offering clear categories for understanding user behavior, context, and daily activities. This segmentation helps in developing specific applications for monitoring and supporting elderly individuals.

**Weaknesses:** While the study offers a structured approach to activity modeling, it is limited in scope. It focuses primarily on ontology categorization and does not fully explore the integration of these ontologies into functioning smart home systems. Additionally, the study does not address the challenges in terms of scalability and the dynamic nature of elderly care needs in real-world applications.

***Comparative Analysis and Gaps in Literature***

Across the studies reviewed, several common themes and gaps emerge.

- **Strengths**

Many studies emphasize the importance of ontologies for managing complex health data, particularly in the context of smart homes and elderly care. The integration of AI and machine learning is highlighted as crucial for improving the effectiveness of health monitoring and decision-making systems.

- **Weaknesses and Gaps**

- **Practical Implementation:** Few studies address the real-world challenges of implementing these technologies, especially in diverse elderly populations with varying health conditions. For example, Sapci & Sapci (2019) identify a gap in critical appraisal, which affects the reliability of evidence supporting the use of telecare in elderly care.
- **Integration of Ontologies:** While ontologies are proposed as valuable tools for structuring data, studies like Chatterjee et al. (2021) and Ni et al. (2016) do not delve deeply into how these ontologies can be seamlessly integrated into existing healthcare systems or smart home devices.
- **Personalization and Scalability:** There is a need for more research on the scalability of these systems, particularly in terms of adapting to the personalized needs of aging individuals. The challenges of tailoring smart home systems to fit specific medical and lifestyle needs of elderly users remain underexplored in the reviewed literature.

This critical comparison highlights the strengths of existing studies in developing ontologies and AI solutions for elderly care in smart homes. However, gaps remain in the practical integration, personalization, and scalability of these technologies. Further research should focus on overcoming these challenges, particularly in designing systems that are adaptable, reliable, and effective in

supporting elderly individuals' health in real-world settings.

Given this context, we are currently dealing with several different ontologies developed in the field of smart homes. Therefore, gaining an awareness of the different dimensions of ontologies, as well as the stages of maturation and the tendencies for the future, might be beneficial in this sector.

### 3. Method

The current study is a systematic review that was conducted to investigate the studies that were designed to develop an ontology for a smart home that can monitor the health of senior citizens.

To perform this step, the method of Okoli and Shabram was used, which provided a framework to show the steps of conducting a systematic review. This framework has been used in various studies as a guide to conducting systematic studies. The different stages of this method are:

- 1) **Planning:** Determining the purpose of conducting a systematic review and extracting underlying categories

- 2) **Selection:** Identifying articles from reliable databases, reading the abstract and title, reading the introduction and conclusion, evaluating the articles, selecting eligible articles

- 3) **Extraction:** Creating a data recording form and extracting the desired information

- 4) **Implementation:** Analyzing the findings (Okoli & Schabram, 2015)

The search via the available literature was carried out in 25 August 2024. Our access at Tarbiat Modares University led us to select the following literature repositories and databases for the search: Scopus, IEEE, PubMed, Medlin, NLM, and Google Scholar. Additionally, we focused on studies about elderly health, ontology, and smart homes.

Using Google Dictionary, a number of different concepts that are synonymous with one another were combined, and the final set of keywords consisted of a combination of four different sets of keywords: (1) elderly, (2) health, (3) smart home, and (4) ontology.

Table 2. Keywords and synonyms

Keywords	Synonyms
elderly	lder, old, aging, aged, senile, senescent, gray, senior
health	Wholesome, safety, security, wellness, wellbeing
smart home	Smart environment, internet of things, iot
ontology	conceptual model, semantic model

All of the publications were reviewed by two co-authors who applied the inclusion and exclusion criteria to each one.

Inclusion criteria:

- Published full text in English
- Peer-reviewed journal articles and published conference papers
- Studies that focused on the modeling and suggested an ontology
- Studies set in smart homes on elderly health

Exclusion Criteria:

- Published in a language other than English

- The full text was not available in any way
- Literature reviews and systematic reviews
- Book chapters, theses, magazine articles, reports, letters and working papers
- Articles that did not clearly address the relationship of the research conducted with ontology, aging, and smart homes.
- Articles whose data were duplicated and published in more than one journal.

The data search and screening are illustrated in Figure 1.

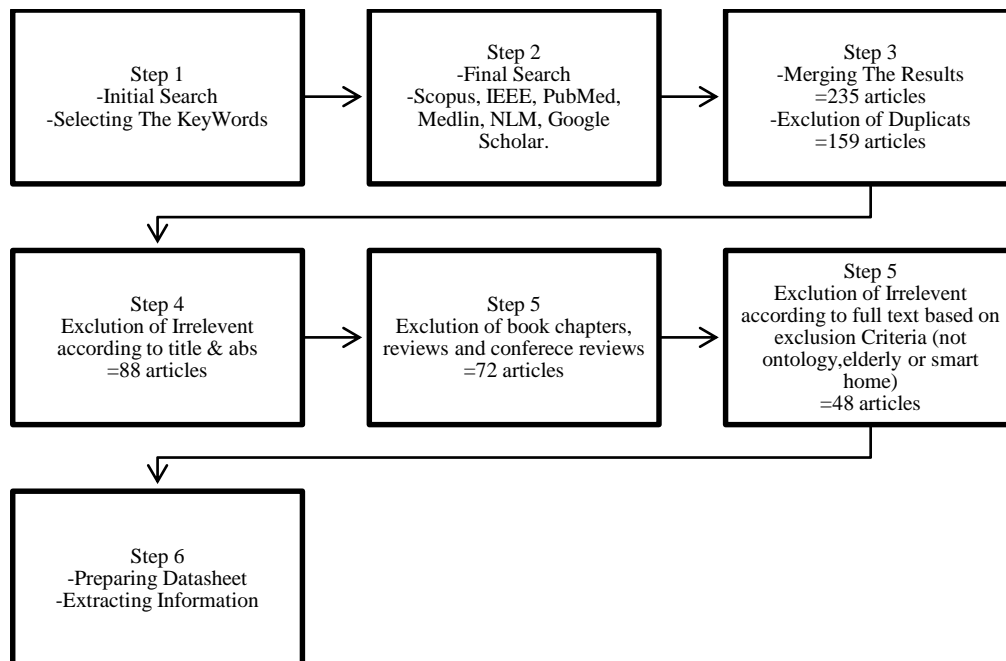


Figure 1. Data search and screening steps

#### 4. Finding

As can be seen in Figure 1, we were finally able to extract our findings from a total of 48 papers. We analyzed the article's study technique, the purpose of using IoT, the utilized IoT tools and technologies, the used language and software to construct the ontology, as well as the most important results that were given.

We discovered 28 publications that made use of an ontology in the process of designing a smart home, in addition to 20 articles that proposed a new ontology. Ontologies were developed with a variety of domains and dimensions, all of which were based on the various health monitoring requirements of individuals. Also, the designs that were based

on ontologies often led to the construction of a system or an application that can be said to be an optimal program for gathering,

processing, and reusing data when used in conjunction with this technique.

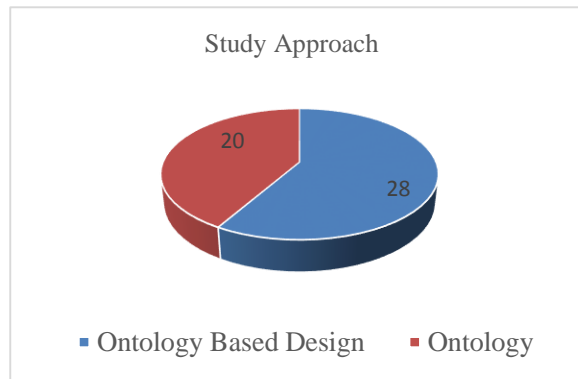


Figure 2. Studies main approach

The monitoring of the health and safety circumstances of older participants was by far the most common reason for utilizing IoT solutions in research.

utilizing the Internet of Things in the health field. This is something that should be kept in mind. However, the observation of fields that require machine analysis and calculations, such as prediction and diagnosis, in recent studies promises that in the future, the use of ontologies will lead to a change in the direction that telehealth services take.

In this regard, it is important to keep in mind that owing to the rising and expanding nature of this sector, it is evident that most studies have been done on the simplest form of

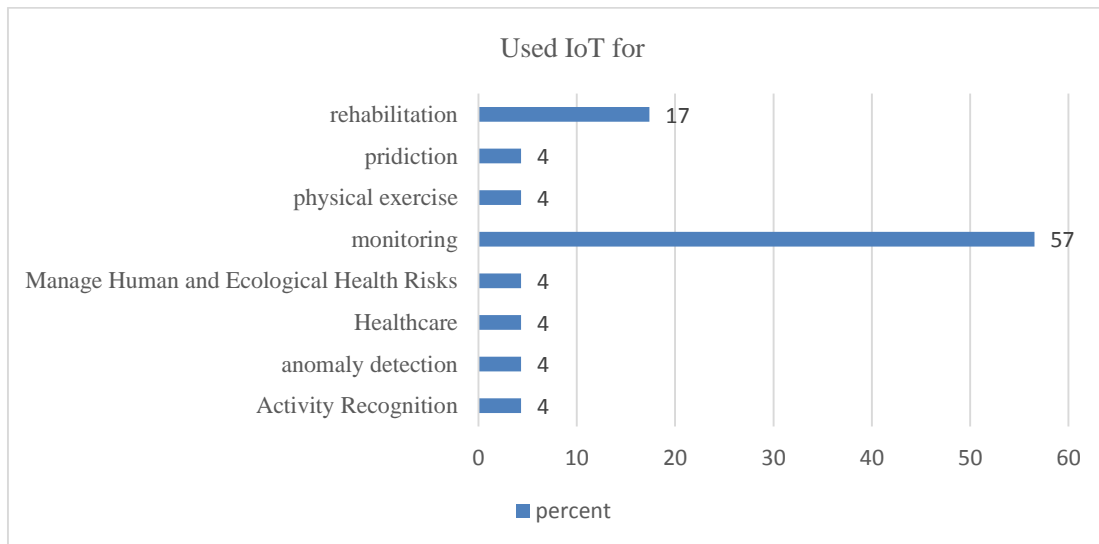


Figure 3. The main purpose of using IoT in healthcare

Out of a total of 48 research studies that were examined, 18 publications investigated the suggested ontology or an ontology-based architecture. The study case, reasoning performance, and experimental setup are some of the most common ways to evaluate the suggested ontologies, as demonstrated in Figure 4. In addition, an example scenario is

a type of simulation, and if the testing technique were to include a complete simulation, it may be considered acceptable.

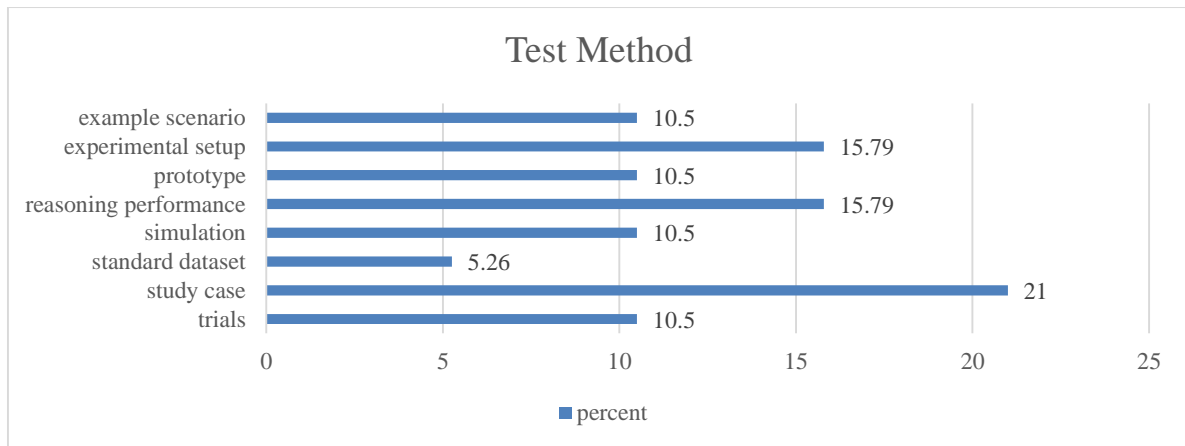


Figure 4. Ontology testing method (Percentage)

The following chart presents published articles up to the date of the search (March 2020) as a function of time. By the time designed ontologies are mature, they will have a great deal of dimension diversity and

will have gone through the maturation process. Additionally, as is evident from looking at Figure 5, there has been a rising trend in the total number of articles that have been published in this sector.

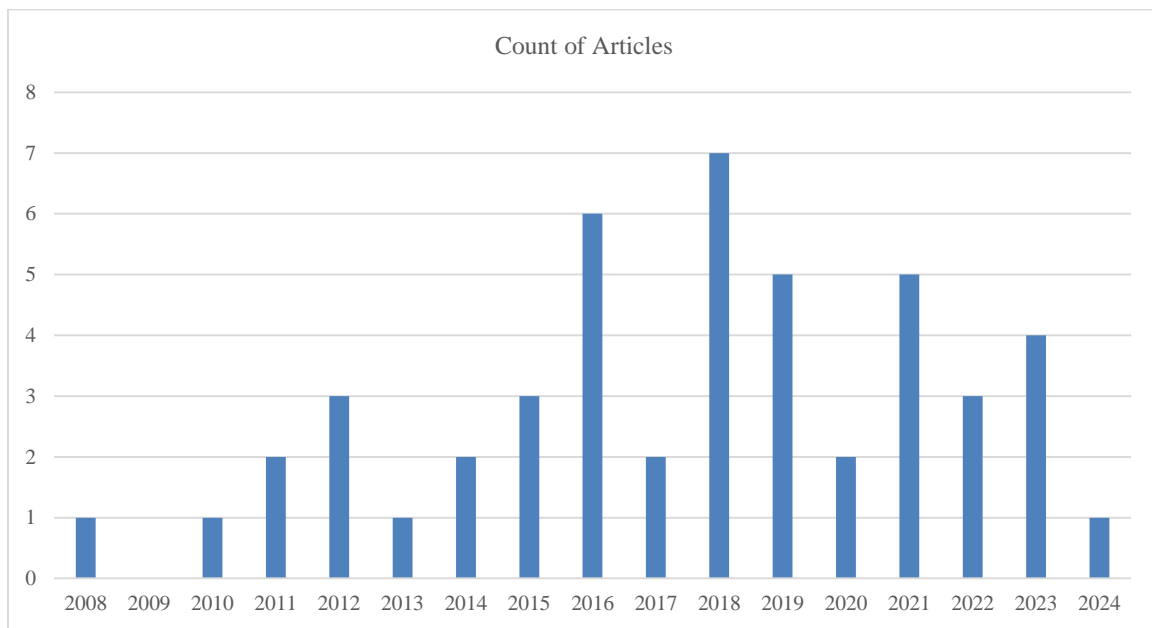


Figure 5. Count of articles each year

Articles claimed that sensors, such as environmental sensors, biosensors, and wearable sensors, were the most common kind of Internet of Things instruments deployed (Bialas, 2016), (Calvaresi & Calbimonte, 2020), (Evchina, Dvoryanchikova, & Lastra, 2012), (Garcia-Valverde, Muñoz, Arcas, Bueno-Crespo, & Caballero, 2014), (Hamidi & Fazeli, 2018), (Hong & Nugent, 2011), (Ivaşcu & Negru, 2021), (Jin & Kim, 2018), (Kymäläinen, Plomp, Tuomisto, Heinilä, & Urhema,

2017), (Meng et al., 2018), (Paganelli, Spinicci, & Giuli, 2008), (Salguero, Espinilla, Delatorre, & Medina, 2018), (Spoladore & Sacco, 2018), (Vergari et al., 2011).

An emerging and potentially fruitful area of application for smart homes for the elderly is the participation of robots in social activities. An important study was conducted using three different social robots named Buddy, ASTRO, and RoboHon to help older persons maintain their independence while living at home and increase their socializing. The

robots are programmed with three different emotional-based applications: mobility, daily life, and conversational. These applications were conceived using the Listen, Innovate, Field-test, and Evaluate (LIFE) co-creation methodology for the Internet of Things. This methodology integrates human factors to cater to the requirements of elderly people. In addition to this, they have outlined the knowledge API to reuse expertise from

communities that span several domains (for example, robotics, IoT, health, and emotional sciences) (Gyrard et al., 2021). This aspect of the ontology of smart homes will be appealing and will continue to evolve.

Using Kinect for monitoring and rehabilitation (Anton, Berges, Bermúdez, Goñi, & Illarramendi, 2018) (Baldassini, Colombo, Spoladore, Sacco, & Arlati, 2017) was an attractive application.

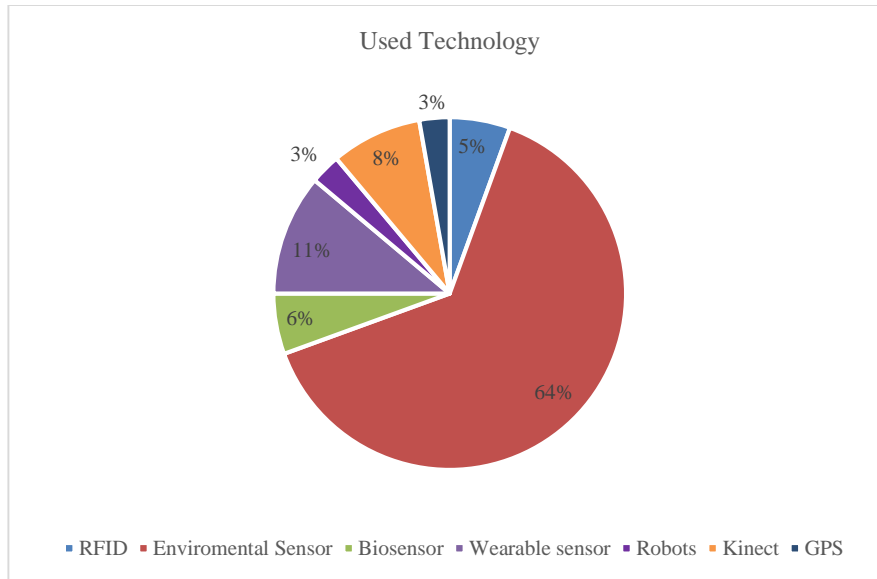


Figure 6. Used IoT tools and technologies

Some ontologies are designed for a specific group of people or disease control of a specific disease such as Chronic obstructive pulmonary (Ajami, Mcheick, & Mustapha, 2019) or just daily life activities (Bae, 2014), (Khattak, Khan, Pervez, Iqbal, & Lee, 2016), (Zolfaghari, Zall, & Keyvanpour, 2016) or specific services (Huang, Yi, Zhu, & Chen, 2016) which naturally will be limited to the topic.

There are three important aspects of the aging process: (1) Physiological Status and Behavior, (2) Nutrition, and (3) Cognitive and Mental Status and Social Behavior (Mastropietro et al., 2021). The ontological representation of the domains of knowledge that are engaged within a smart home aids the residents in conducting some Activities of Daily Living; this allows users to regulate indoor comfort metrics and provides them

with support in meal preparation (Spoladore, Mahroo, Trombetta, & Sacco, 2022).

Recent research has resulted in the development of a meaningful, context-specific ontology for the modeling of massive, unintuitive, raw, and unstructured observations for health and wellness data (such as sensors, interviews, and questionnaires). This ontology is used to annotate these observations with semantic metadata to produce a compact, understandable abstraction for health risk predictions that can be used for the generation of individualized recommendations (Ayan Chatterjee, Andreas Prinz, Martin Gerdes, & Santiago Martinez, 2021). As a result, we need to conduct ever-more-detailed investigations on the medical information and models now available for forecasting and diagnosing the illness.

The detection of activity and the combination of visual and sensor modalities

are both current trends in the future. The semantic system still has some unfinished business to take care of, including the application of more advanced reasoning rules and the upgrading of the ontologies to reflect additional information (Mavropoulos et al., 2021).

The use of ontology-based systems in the evaluation of the danger of older persons falling, the detection of abnormalities, the management of diabetes, and emergencies is becoming an increasingly common occurrence (Gayathri, Easwarakumar, & Elias, 2020) (El-Sappagh, Ali, Hendawi, Jang, & Kwak, 2019) (Rhayem, Mhiri, Drira, Tazi, & Gargouri, 2021) (Bennasar et al., 2019) (Sfar & Bouzeghoub, 2018).

In one of the articles, we come across a proposed algorithm by a Contextual-based strategy that makes use of the ontology method to anticipate emotions based on the problems experienced by elderly folks. The progressive estimation provides the assessment data to the doctor or caregiver for them to provide the appropriate treatment based on the scores obtained in the older adult's mood to provide the appropriate treatment based on the scores obtained in the older adult's mood prediction (Harish & Gayathri, 2019). In light of the high

prevalence of depression and diseases related to it among the elderly population, the use of such innovative approaches calls for additional research but has the potential to be of great benefit in terms of mood.

The Smart Home Care Project (Alirezaie et al., 2017) has been a valuable research for the use of ontology with the aim of integrating measured information from heterogeneous sources and interpreting the semantics of events and context awareness, and the results of the implemented experimental scenario demonstrate the system's ability to identify activities and provide a suitable basis for inference and decision-making regarding activities. In this project, as mentioned in the researcher's subsequent research, the elderly can be considered as a special group that needs home care (Alirezaie et al., 2018). In this project, which has been implemented in Sweden, the greatest focus is on the connection of the data produced with the electronic health record, which has a significant history in Sweden as an integrated system.

Among the articles we reviewed, a number of articles clearly mentioned classes, entities, and measurable variables in the smart home. Based on the dimensions of health, we categorized these variables in the table 3.

**Table 3. Published Ontologies**

Ontology Name	Physical Health	Mental Health	Social Health	Ref.
NESTORE	Physiological status and behavior of physical activity, nutrition	Psychological and cognitive status	social behavior	(Mastropietro et al., 2021)
NeON	Daily activity pattern (feeding, sleep, indoor activities, personal care, medications)	-	-	(Ni et al., 2016)
EHA	Physiological information	-	-	(T. C. Chiang & W. H. Liang, 2015)
-	Daily functions (motion tracking, eating), medical information (consultation system, reminder), daily habits (cigarette sensor, bed sensor)	-	-	(Miori & Russo, 2012)
-	Human tissue information (medical file, personal information, health status), Information Wearable sensors (temperature and heart rate)	-	-	(Nugroho, Lazuardi, & Non-alinsavath, 2015)
Bi-LSTM	Documents, medical and biological information	-	-	(Alti, Laborie, & Roose, 2015)
-	Activities Residents' daily life, residents' personal condition, including physical conditions	The personal condition of the residents including mental states	-	(Trinugroho, Reichert, & Fensli, 2012)
DOMUS	Individual health status (including sub-domains of body functions, bad structures)	-	Individual health status (activity and participation)	(Spoladore et al., 2022)
-	Patient information, physical health information	-	-	(Rhayem et al., 2021)

UiA eHealth Ontology	behavioral habits, basic information on health and physical condition, nutrition, personal and demographic information, environmental conditions, physical activity, sleep status, physiological information	-	-	(A. Chatterjee et al., 2021)
-	Body function and structure, activities, daily habits, personal information	-	-	(Ajami et al., 2019)
-	Physiological information, basic information, information on diseases and drugs	-	-	(Sondes et al., 2019)
-	Activities, risks	-	-	(Huang et al., 2016)
-	Nutrition	-	Social activity, amount of interaction, place of interaction	(Khattak et al., 2016)
RADL	Daily life activity including individual activities	-	Daily life activities including social activities	(Bae, 2014)

Ontologies in healthcare are evolving to better manage and process complex health data, ultimately aiding in the prediction of health status and enhancing care. Initially, ontologies were used to standardize medical terminology and organize data across different systems. Over time, their role has expanded to include more dynamic, real-time applications in healthcare.

The evolution of healthcare ontologies is driven by several key factors:

•**Incorporation of New Dimensions:** Modern ontologies are increasingly incorporating new dimensions beyond traditional clinical data. These include mental health, nutrition, social behavior, and lifestyle factors. This broader scope allows for a more holistic view of a patient’s health and well-being.

•**Personalized and Precision Medicine:** Ontologies are evolving to support precision medicine, which tailors treatments to individuals based on their genetic, environmental, and lifestyle factors. They enable the integration of various types of data (e.g., genomic, environmental, behavioral) to predict health outcomes and provide personalized care recommendations.

•**Integration with Advanced Technologies:** The use of ontologies is expanding with the integration of technologies like the Internet of Things (IoT), wearable health devices, and artificial intelligence (AI). These technologies collect real-time health data, and ontologies help structure and interpret this data to support predictive health systems.

•**Knowledge Processing and Decision Support:** Ontologies are becoming central to creating

advanced knowledge processing systems that analyze complex health data and predict future health events. By structuring health-related knowledge in a formalized way, ontologies enable the development of intelligent systems that can assist in early diagnosis, disease prevention, and treatment recommendations.

•**Interdisciplinary Applications:** Healthcare ontologies are also evolving to facilitate interdisciplinary collaboration, particularly in areas like elderly care, where factors like cognitive health and social behavior are as important as physical health. These ontologies support the development of integrated care systems that can predict and respond to various health issues across different domains.

In summary, healthcare ontologies are evolving from simple data structures to advanced tools that enable predictive health models and personalized care, thus improving the ability to foresee health status changes and provide proactive interventions.

## 5. Discussion

Ontology development processes are not insignificant, given the inherently complex nature of knowledge acquisition and management. As well as the need to provide a structured and methodical approach to the process methodology to be accepted and usable. If we intend to develop an ontology for multidimensional concepts, such as well-being, aging, and health, it is clear that knowledge from multiple domains must be included. (Belani, Šolić, Perković, & Pleština, 2023) Comparative to other smart

health care services integration systems, the ontological model provides more cohesiveness (Naqvi et al., 2023). The investigation of ontology models that were presented in the studies reveals that the dimensions of ontologies experience a great deal of variation and mature through a process over time.

The first ontological models focused on the taxonomy of devices and their functionalities, as well as the taxonomy of home furniture, the ontology of the environments within which devices and furniture can be positioned, and the definition of words that specify the positions of objects and devices within the environment (Miori & Russo, 2012) (T.-C. Chiang & W.-H. Liang, 2015). After that, people and their status were added to the ontologies, and the activities of the inhabitants, the personal state of the inhabitants, the location of the inhabitants, and the surrounding ambient smart home states formed parts of the defined ontology (Trinugroho et al., 2012).

We can see that the components of ontology have evolved into dimensions such as users,

sensors, places, physical objects, temporal information, activities, and ADL patterns as a result of an evolutionary process (Ni et al., 2016). The human context characteristic that was added consists of feedback, preference, medical reference, personal information, additional information, position, and medical record. This characteristic describes information about the user's surrounding environment. In addition to that, the Machine Learning Context, the Bio Context, and the Medical Context emerged (Nugroho et al., 2015) (Alti et al., 2015).

In more recent ontologies, newer dimensions such as nutritional status, cognitive and mental status, and social behavior have been observed. Examples of these include physiological status and the behavior of engaging in physical activity (Mastropietro et al., 2021).

As can be seen in figure7, there have been three distinct generations of ontologies developed for the topic of healthcare in the smart home for older people.

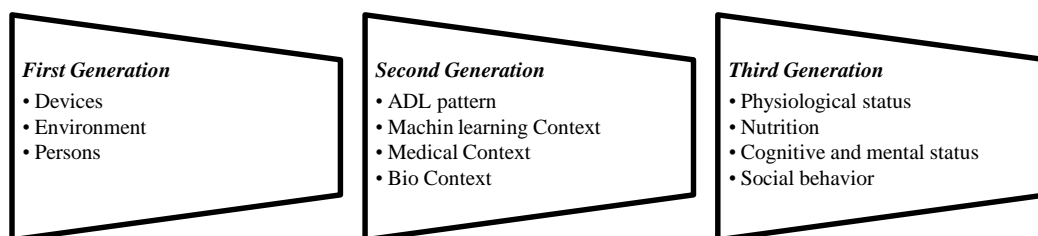


Figure 7. Proposed ontologies generation

Aged care monitoring, chronic patient healthcare monitoring, Human Activity Recognition (HAR), Clinical Applications, Emergency conditions, Mental Health, Movement disorders, Rehabilitation, Preventive measures, Accessibility to healthcare services, and Accessibility for caregivers are some of the areas of application for the internet of things in elderly healthcare (Tun, Madanian, & Mirza, 2021).

Another important issue is the accuracy of ontology-based systems when monitoring the elderly. The ontology-driven semantic interoperability agent showed robust

accuracy in monitoring elderly people's activities, mobility patterns, and providing accurate recommendations for mobilization at home (Karagiorgou et al., 2018). The ontology in the Arduino-based health monitoring system ensures accurate monitoring of elderly people, enabling remote patient monitoring and fast response in critical situations. It allows remote monitoring of patients by doctors and family members (Costanzo & Pino, 2014). The ontology-based healthcare monitoring system in the Internet of Things showed feasibility and efficiency in semantic querying,

indicating promising accuracy for monitoring elderly people (Sondes et al. 2019). In addition, the elderly monitoring ontology in Zulfiqar's study showed 100% sensitivity for geriatric risks with satisfactory positive and negative predictive values, indicating high accuracy in detecting health deterioration (Zulfiqar et al., 2022). Also, the ontology-based system for monitoring independent seniors aims to accurately detect potential dangers without wearable devices, enhancing their safety and independence at home (Blaya, Palma, Villa, Perez, & Iborra, 2009). In the not-too-distant future, it is anticipated that the traces of all of these applications will be visible within the ontology of smart homes.

### **Future Trends**

According to what has been discussed, it would appear that, as time has passed, ontologies have evolved toward greater personalized service and have begun to pay more attention to the human and social needs of their users. On the other hand, the future of IoT applications in healthcare will include the following trends: blockchain<sup>1</sup>, tactile internet<sup>2</sup>, online social networks, big data analytics, service quality, and the internet of nano things (Kashani, Madanipour, Nikravan, Asghari, & Mahdipour, 2021). As a result, the following areas are good places to look for emerging tendencies in the ontology research of smart homes, particularly about the monitoring of the health of the elderly:

### **Precision Medicine<sup>3</sup>**

With the advent of the Internet of Nano Things (IoNT), numerous applications can be identified by IoNT for the field of healthcare. These applications include nanorobots that can deliver drugs to specific organs with high precision, nanosensors, precision medicine, minimally invasive surgery, and a multitude of nanorobots for human body parts that are not currently available. In the end, IoNT is leading the charge in the revolution of

nanoscale networking, which will ultimately have applications in sensing and precision medicine as a future trend.

### **Tactile Internet**

The next revolutionary generation will be the Tactile Internet, which will allow us to control Internet of Things (IoT) equipment in the physical world and in real time. The use of TI in healthcare can be put to use in a variety of different ways, including the suppression of tremors in Parkinson's disease, telesurgery, interactive medical education, trauma rehabilitation, education and rehabilitation based on virtual and augmented reality, and so on. Therefore, TI applications have the potential to be used in HIoT, which can result in promising opportunities in the future and will add a new dimension to ontologies.

### **Feedback System**

There is potential for new dimensions to be introduced into ontologies, such as the launching of interactive systems and the receipt of feedback regarding service quality. In addition, technologies such as machine learning and automatic inference can be improved by receiving these feedbacks and analyzing them.

### **Role of Data Processing and Advanced Analytics for Precision Medicine in Smart Homes for the Elderly**

Precision medicine is an approach to healthcare that considers individual differences in genes, environments, and lifestyles to provide tailored treatments and prevention strategies. Data processing and advanced analytics play a critical role in the development and application of precision medicine, particularly in smart homes for the elderly. These technologies help process vast amounts of health-related data, predict disease risk, and deliver personalized care. Below is an explanation of how these technologies contribute to precision medicine

<sup>1</sup> A system in which a record of transactions, especially those made in a cryptocurrency, is maintained across computers that are linked in a peer-to-peer network. <https://en.wikipedia.org/wiki/Blockchain>

<sup>2</sup> The Tactile Internet refers to a communication framework that enables real-time, interactive experiences with sensory feedback, such as touch and feel, over the internet. It combines ultra-low latency and high-speed networks (like 5G) to allow users to remotely interact with objects and environments, perceiving tactile sensations like texture, pressure,

and movement. This technology is crucial for applications like remote surgery, virtual reality, and remote robotic. (Rajesh et al., 2024)

<sup>3</sup> Precision medicine is an innovative approach to healthcare that tailors medical treatment and interventions to individual patients based on their genetic makeup, lifestyle, and environmental factors. Unlike the traditional "one-size-fits-all" approach, precision medicine aims to provide more effective treatments by considering personal differences in genes, environment, and lifestyle. (Purnomo & Sanjaya, 2024)

and their application in smart homes for aging populations. (Morita, Sahu, & Oetomo, 2023)

### **1. Data Processing in Precision Medicine**

Data processing in precision medicine involves collecting, storing, and analyzing large volumes of health data from various sources, such as medical records, wearable devices, and environmental sensors. Advanced data processing techniques, including machine learning (ML) and artificial intelligence (AI), are used to extract meaningful insights from this data. These insights help predict potential health risks, understand disease progression, and recommend personalized treatments or preventive measures.

**Health Data Integration:** In smart homes, various devices (e.g., wearables, sensors) continuously collect health data, such as heart rate, blood pressure, and physical activity levels. This data, combined with other information such as medical history, can be processed to identify patterns and trends that may indicate a health problem. Advanced analytics techniques can recognize early signs of diseases like cardiovascular issues or dementia, enabling timely intervention (Sicilia, Sánchez-Alonso, García-Barriocanal, & Pontikaki, 2009).

**Disease Prediction:** Precision medicine relies on predictive models that analyze data to forecast the likelihood of diseases. Advanced analytics, including AI and deep learning algorithms, can analyze genomic data, lifestyle factors, and environmental exposures to predict the onset of chronic diseases such as diabetes, Alzheimer's disease, and hypertension. In elderly populations, early detection of these conditions allows for personalized intervention, helping to slow disease progression or improve quality of life (Alowais et al., 2023).

### **2. Advanced Analytics in Disease Prediction**

Advanced analytics methods like machine learning and AI are crucial in the context of smart homes for the elderly, as they can detect early symptoms and predict health risks in real-time. These technologies use a combination of historical data, sensor inputs,

and demographic information to create predictive models for disease diagnosis and treatment optimization.

**Real-Time Monitoring:** In a smart home, continuous monitoring via IoT devices can track daily activities and health metrics of elderly individuals. Data collected by sensors (e.g., fall detection, movement patterns, room temperature, sleep quality) is analyzed in real-time to detect abnormal patterns, which might indicate early-stage health issues such as a fall risk, cognitive decline, or other physical impairments (Shukla, 2023).

**Personalized Interventions:** By analyzing these patterns, advanced analytics can personalize health interventions for elderly individuals. For instance, if an individual shows early signs of a health issue like high blood pressure or irregular heart rate, an alert can be sent to caregivers or healthcare providers. This allows for personalized interventions that are tailored to the individual's needs, improving outcomes and reducing unnecessary hospital visits (Winter, 2019).

### **3. Applications of Precision Medicine and Data Analytics in Smart Homes for the Elderly**

Smart homes, equipped with IoT devices and sensors, can create an integrated environment where elderly individuals are continuously monitored for health status and safety. Data processing and advanced analytics contribute significantly to the healthcare and well-being of elderly residents.

**Chronic Disease Management:** For elderly individuals managing chronic conditions, smart homes equipped with health monitoring devices can provide ongoing health tracking. Advanced analytics can process this real-time data to detect changes in health status that may require medical attention. For example, continuous blood glucose monitoring can help predict episodes of hypoglycemia in diabetic patients, prompting immediate care (Esch, 2013).

**Cognitive Health and Mental Well-being:** Dementia and cognitive decline are common concerns among the elderly. Smart home systems can track behavioral patterns, sleep

quality, and daily routines to detect subtle changes in cognition. Data analytics can analyze these patterns to predict cognitive decline or depression, providing early intervention and supporting personalized care strategies (Majumder et al., 2017).

**Fall Prevention:** Falls are a significant risk for elderly individuals and often lead to severe injuries. Smart homes use motion sensors, accelerometers, and fall detection algorithms to identify falls in real-time. Predictive analytics can also assess the risk of falling based on gait patterns, previous fall history, and environmental factors, thus preventing accidents before they happen (Karar, Shehata, & Reyad, 2022).

Data processing and advanced analytics play an essential role in enhancing precision medicine, particularly in the context of smart homes for the elderly. By leveraging real-time data collection, machine learning, and predictive models, these technologies enable disease prediction, early intervention, and personalized care. Smart homes can offer elderly individuals more autonomy, safety, and improved health outcomes by continuously monitoring their well-being and responding to emerging health risks. This integration of healthcare with smart home technologies marks a significant advancement in both elderly care and precision medicine.

## 6. Conclusion

In this article, we take a look at the research that has been done in the area of ontology regarding the benefits of smart homes for elderly people's health. These types of ontologies are particularly important from the perspective of assisting in the generation, processing, and utilization of data about people's health as well as the development of care and personalized medicine. We classified three generations of ontologies by studying the designed ontologies and comparing their dimensions and characteristics. Based on our findings, we predicted that future trends in this field will include precision medicine, the tactile internet, and feedback systems. Nutrition,

cognitive and mental status, and social behavior have all been identified as new dimensions in recent ontologies. Physiological status and the behavior of engaging in physical activity also fall into this category.

One of the limitations of our research was the limited number of studies that were conducted. By including original articles that were presented at conferences, we attempted to make up for this deficiency to some degree. A study that provides an overview of related work on ontology-based cybersecurity shows the dual need for ontologies in such systems—first to structure the meaning of well-being and health data, and second to structure the meaning of approaches, practices, techniques, and etc. cyber security to protect this data (Belani, Šolić, & Perković, 2022). This topic has recently appeared in ontology and is an important and attractive field for future research.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix 1

Articles after step 3

Exclusion /Inclusion	Authors	Title	Year	Source title
Relevant	Dahhani, A. Ngankam, H. K. Giroux, S. Alloui, I. Monnet, S. Vernier, F.	Ontology Alignment: First Step towards Voice Control for Smart-Home Assistive Scenarios	2024	20th International Wireless Communications and Mobile Computing Conference, IWCMC 2024
Relevant	Kristina Zovko, Ljiljana Šerić, Toni Perković, Hrvoje Belani, Petar Šolić,	IoT and health monitoring wearable devices as enabling technologies for sustainable enhancement of life quality in smart environments	2023	Journal of Cleaner Production
Relevant	Naqvi, Muhammad Raza; Iqbal, Muhammad Waseem; Shahzad, Syed Khuram; Ashraf, M. Usman; Alsubhi, Khalid; Aljahdali, Hani Moaiteq	Ontological Model for Cohesive Smart Health Services Management	2023	Computers, Materials & Continua
Relevant	H Belani, P Šolić, T Perković, V Pleština	IoT Ontology Development Process for Well-Being, Aging and Health: Challenges and Opportunities	2023	8th International Conference on Smart and Sustainable Technologies (SpliTech)
Relevant	H Nabli, I Regaig, RB Djemaa, L Sliman	Never Alone: a Quality of Context-aware Monitoring System for Aging in Place Smart Home	2022	21st International Symposium on Network Computing and Applications (NCA)
Relevant	H Belani, P Šolić, T Perković	Towards ontology-based requirements engineering for IoT-supported well-being, aging and health	2022	30th International Requirements Engineering Conference
Relevant	Feki M.A., Biswas J., Tolstikov A.	Model and algorithmic framework for detection and correction of cognitive errors	2009	Technology and Health Care
Relevant	Hong X, Nugent C.	Implementing evidential activity recognition in sensorised homes	2011	Technol Health Care
Relevant	Georgiou A., Marks A., Braithwaite J., Westbrook J.I.	Gaps, disconnections, and discontinuities- The role of information exchange in the delivery of quality long-term care	2013	Gerontologist
Irrelevant	Peek S.T.M., Luijckx K.G., Rijnaard M.D., Nieboer M.E., Van Der Voort C.S., Aarts S., Van Hoof J., Vrijhoef H.J.M., Wouters E.J.M.	Older Adults' Reasons for Using Technology while Aging in Place	2016	Gerontology
Relevant	Chiang T.-C., Liang W.-H.	A Context-Aware Interactive Health Care System Based on Ontology and Fuzzy Inference	2015	Journal of Medical Systems
Relevant	Fritz R.L., Dermody G.	A nurse-driven method for developing artificial intelligence in "smart" homes for aging-in-place	2019	Nursing Outlook
Irrelevant	Kao Y.-S., Nawata K., Huang C.-Y.	An exploration and confirmation of the factors influencing adoption of IoT-based wearable fitness trackers	2019	International Journal of Environmental Research and Public Health
Relevant	Haidon C, Pigot H, Giroux S.	Joining semantic and augmented reality to design smart homes for assistance	2020	J Rehabil Assist Technol Eng
Irrelevant	Dermody G., Fritz R., Glass C., Dunham M., Whitehead L.	Factors influencing community-dwelling older adults' readiness to adopt smart home technology: A qualitative exploratory study	2021	Journal of Advanced Nursing
Relevant	Ni Q., De La Cruz I.P., Hernando A.B.G.	A foundational ontology-based model for human activity representation in smart homes	2016	Journal of Ambient Intelligence and Smart Environments
Relevant	Mastropietro A., Palumbo F., Orte S., Girolami M., Furfari F., Baronti P., Candea C., Roecke C., Tarro L., Sykora M., Porcelli S., Rizzo G.	A multi-domain ontology on healthy ageing for the characterization of older adults status and behaviour	2021	Journal of Ambient Intelligence and Humanized Computing
Relevant	Rhayem A., Mhiri M.B.A., Drira K., Tazi S., Gargouri F.	A semantic-enabled and context-aware monitoring system for the internet of medical things	2021	Expert Systems

Irrelevant	Yacchirema D.C., Sarabia-Jacome D., Palau C.E., Esteve M.	A smart system for sleep monitoring by integrating IoT with big data analytics	2018	IEEE Access
Relevant	Sfar H., Bouzeghoub A.	Activity Recognition for Anomalous Situations Detection	2018	IRBM
Relevant	Bae I.-H.	An ontology-based approach to ADL recognition in smart homes	2014	Future Generation Computer Systems
Irrelevant	Jiang C., Mita A.	Automatic spatial attribute and travel pattern generation for simulating living spaces for elderly individuals living alone	2020	Building and Environment
Relevant	Kymäläinen T., Plomp J., Tuomisto T., Heinilä J., Urhema T.	Designing smart living for ageing Alice—and the persons next door	2017	Intelligent Buildings International
Relevant	Spoladore D., Mahroo A., Trombetta A., Sacco M.	DOMUS: a domestic ontology managed ubiquitous system	2021	Journal of Ambient Intelligence and Humanized Computing
Relevant	Gayathri K.S., Easwarakumar K.S., Elias S.	Fuzzy ontology based activity recognition for assistive health care using smart home	2020	International Journal of Intelligent Information Technologies
Relevant	Fan Y.J., Yin Y.H., Xu L.D., Zeng Y., Wu F.	IoT-based smart rehabilitation system	2014	IEEE Transactions on Industrial Informatics
Relevant	Gyrard A., Tabeau K., Fiorini L., Kung A., Senge E., De Mul M., Giuliani F., Lefebvre D., Hoshino H., Fabbriotti I., Sancarolo D., D'Onofrio G., Cavallo F., Guiot D., Arzoz-Fernandez E., Okabe Y., Tsukamoto M.	Knowledge Engineering Framework for IoT Robotics Applied to Smart Healthcare and Emotional Well-Being	2021	International Journal of Social Robotics
Relevant	Francillette Y., Bouchard B., Bouchard K., Gaboury S.	Modeling, learning, and simulating human activities of daily living with behavior trees	2020	Knowledge and Information Systems
Relevant	Spoladore D., Sacco M.	Semantic and dweller-based decision support system for the reconfiguration of domestic environments: RecAAL	2018	Electronics (Switzerland)
Relevant	Kim J., Park S.O.	U-Health Smart system architecture and ontology model	2015	Journal of Supercomputing
Relevant	Hamidi H., Fazeli K.	Using Internet of Things and biosensors technology for health applications	2018	IET Wireless Sensor Systems
Relevant	Sabri L., Chibani A., Amirat Y., Zarri G.P., Gatellier P.	Semantic framework for context-aware monitoring of ambient assisted living ecosystems	2015	Ambient Assisted Living
Relevant	Sondes Titi, Hadda Ben Elhadj, Lamia Chaari Fourati	A Fuzzy-Ontology Based Diabetes Monitoring System Using Internet of Things		
Relevant	Konstantin Ryabinin, Svetlana Chuprina	Ontology-Driven Edge Computing		
Relevant	Gerdes M., Reichert F., Pettersen Nyttun J., Fensli R.	Future Telehealth and Telecare Reference Design based on IoT Technologies: From Remote Monitoring to Smart Collaborative Services with Decision Support	2015	Studies in Health Technology and Informatics
Irrelevant	Martin-Ruiz M.-L., Valero M.-A., Gómez A., Torcal C.	A cooperative decision support system for children's neurodevelopment monitoring	2016	Lecture Notes of the Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering, LNICST
Irrelevant	Sukor A.S.A., Setchi R., Ji Z.	Abnormality Detection Approach in Smart Homes using Case-based Reasoning	2020	2020 IEEE International Conference on Automatic Control and Intelligent Systems, I2CACIS 2020 - Proceedings
Relevant	Flores-Martin D., Laso S., Berrocal J., Canal C., Murillo J.M.	Allowing iot devices collaboration to help elderly in their daily lives	2020	Communications in Computer and Information Science
Relevant	Alsulami M.H., Atkins A.S., Champion R.J., Alaboudi A.A.	An enhanced conceptual model for using ambient assisted living to provide a home proactive monitoring system for elderly saudi arabians	2018	Proceedings of IEEE/ACS International Conference on Computer Systems and Applications, AICCSA

Irrelevant	Koo D.D., Lee J.J., Sebastiani A., Kim J.	An Internet-of-Things (IoT) System Development and Implementation for Bathroom Safety Enhancement	2016	Procedia Engineering
Relevant	Bae I.-H., Kim H.G.	An ontology-based ADL recognition method for smart homes	2011	Communications in Computer and Information Science
Relevant	Titi S., Elhadj H.B., Chaari L.	An ontology-based healthcare monitoring system in the internet of things	2019	2019 15th International Wireless Communications and Mobile Computing Conference, IWCMC 2019
Relevant	Trinugroho Y.B.D., Reichert F., Fensli R.	An ontology-enhanced SOA-based home integration platform for the well-being of inhabitants	2012	Proceedings of the IADIS International Conference e-Health 2012, EH 2012, Part of the IADIS Multi Conference on Computer Science and Information Systems 2012, MCCSIS 2012
Relevant	Miori V., Russo D.	Anticipating health hazards through an ontology-based, IoT domotic environment	2012	Proceedings - 6th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing, IMIS 2012
Relevant	Kareem S.Y., Buoncompagni L., Mastrogiovanni F.	Arianna +: Scalable Human Activity Recognition by Reasoning with a Network of Ontologies	2018	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
Relevant	Kaur A., Isha, Rai G., Malik A.	Authentication and Context Awareness Access Control in Internet of Things: A Review	2018	Proceedings of the 8th International Conference Confluence 2018 on Cloud Computing, Data Science and Engineering, Confluence 2018
Relevant	Sfar H., Ramoly N., Bouzeghoub A., Finance B.	CAREIDAS: Context and activity recognition enabling detection of anomalous situation	2017	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
Relevant	Alti A., Laborie S., Roose P.	Cloud semantic-based dynamic multimodal platform for building mhealth context-aware services	2015	2015 IEEE 11th International Conference on Wireless and Mobile Computing, Networking and Communications, WiMob 2015
Relevant	Henaïen A., Ben Elhadj H., Chaari Fourati L.	Combined Machine Learning and Semantic Modelling for Situation Awareness and Healthcare Decision Support	2020	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
Relevant	Baldassini D., Colombo V., Spoladore D., Sacco M., Arlati S.	Customization of domestic environment and physical training supported by virtual reality and semantic technologies: A use-case	2017	RTSI 2017 - IEEE 3rd International Forum on Research and Technologies for Society and Industry, Conference Proceedings
Relevant	Sommaruga L., Formilli T., Rizzo N.	DomoML - An integrating devices framework for ambient intelligence solutions	2011	ACM International Conference Proceeding Series
Irrelevant	Cristescu I., Bajenaru L.	Elderly smartwatch adoption: A conceptual model development	2021	Proceedings of the 13th International Conference on Electronics, Computers and Artificial Intelligence, ECAI 2021
Relevant	Cacciagrano D., Corradini F., Culmone R., Merelli E., Vito L.	Healthcare tomorrow: Toward self-adaptive, ubiquitous and personalized services	2011	UBICOMM 2011 - 5th International Conference on Mobile Ubiquitous Computing, Systems, Services and Technologies; PECES 2011 - 3rd International Workshop on Pervasive Computing in Embedded Systems
Irrelevant	Kharazian Z., Rahat M., Fatemizadeh E., Nasrabadi A.M.	Increasing safety at smart elderly homes by Human fall detection from video using transfer learning approaches	2020	30th European Safety and Reliability Conference, ESREL 2020 and 15th Probabilistic Safety Assessment and Management Conference, PSAM 2020
Relevant	Bennasar M., Price B.A., Stuart A., Gooch D., McCormick C., Clare L., Bennaceur A., Cohen J., Bandara A.K., Levine M., Nuseibeh B.	Knowledge-based architecture for recognising activities of older people	2019	Procedia Computer Science
Relevant	Evchina Y., Dvoryanchikova A., Lastra J.L.M.	Ontological framework of context-aware and reasoning middleware for smart homes with health and social services	2012	Conference Proceedings - IEEE International Conference on Systems, Man and Cybernetics
Relevant	Kurnianingsih, Nugroho L.E., Widyawan, Lazuardi L., Non-Alinsavath K.	Ontology-based context aware for ubiquitous home care for elderly people	2016	ICITACEE 2015 - 2nd International Conference on Information Technology, Computer, and Electrical Engineering: Green Technology Strengthening in Information Technology, Electrical and Computer Engineering Implementation, Proceedings

Relevant	Bajenaru L., Dobre C., Ciobanu R.-I., Balog A.	Patient profile using ontologies in an older adults monitoring IoT-based platform	2019	2019 7th E-Health and Bioengineering Conference, EHB 2019
Relevant	Kim J., Choi H.-S., Wang H., Agoulmine N., Deen M.J., Hong J.W.-K.	POSTECH's U-health smart home for elderly monitoring and support	2010	2010 IEEE International Symposium on "A World of Wireless, Mobile and Multimedia Networks", WoWMoM 2010 - Digital Proceedings
Relevant	Ishwarya M.S., Aswani Kumar C.	Quantum Inspired High Dimensional Conceptual Space as KID Model for Elderly Assistance	2020	Advances in Intelligent Systems and Computing
Relevant	Harish S., Gayathri K.S.	Smart home based prediction of symptoms of alzheimer's disease using machine learning and contextual approach	2019	ICCIDS 2019 - 2nd International Conference on Computational Intelligence in Data Science, Proceedings
Relevant	Alirezaie M., Hammar K., Blomqvist E., Nystrom M., Ivanova V.	SmartEnv ontology in E-care@home (Short paper)	2018	CEUR Workshop Proceedings
Relevant	Zolfaghari S., Zall R., Keyvanpour M.R.	SOnAr: Smart Ontology activity recognition framework to fulfill semantic web in smart homes	2016	2016 2nd International Conference on Web Research, ICWR 2016
Relevant	Stavropoulos T.G., Strantsalis D., Nikolopoulos S., Kompatsiaris I.	The activate marketplace: Hybrid logic- and text-based discovery of active and healthy ageing iot applications	2021	Advances in Intelligent Systems and Computing
Irrelevant	Bordini R.H., Mascardi V., Costantini S., El Fallah-Seghrouchni A., Lespérance Y., Ricci A.	Transcultural health-aware guides for the elderly	2020	CEUR Workshop Proceedings
Irrelevant	Fugini M., Barengi A., Comai S., Pelosi G., Tedesco R., van Gasteren M., Catalina C.A., Leal E.A., Durán R.L., de Almeida R.M.R., Grau A., Bueno Y., Mertens A., Rick V., Gunes H., Xu T., Borghini G., Ronca V., Sagha H.	WorkingAge: Providing occupational safety through pervasive sensing and data driven behavior modeling	2020	30th European Safety and Reliability Conference, ESREL 2020 and 15th Probabilistic Safety Assessment and Management Conference, PSAM 2020
Not Article	[No author name available]	12th IEEE International Conference on e-Health Networking, Application and Services, Healthcom 2010	2010	12th IEEE International Conference on e-Health Networking, Application and Services, Healthcom 2010
Not Article	[No author name available]	12th International Conference on Smart Homes and Health Telematics, ICOST 2014	2015	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
Not Article	[No author name available]	13th International Conference on Complex, Intelligent, and Software Intensive Systems, CISIS 2019	2020	Advances in Intelligent Systems and Computing
Not Article	[No author name available]	13th International Conference on Smart Homes and Health Telematics, ICOST 2015	2015	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
Not Article	[No author name available]	15th International Conference on Human-Computer Interaction, HCI International 2013	2013	Communications in Computer and Information Science
Not Article	[No author name available]	15th International Conference on Smart Homes and Health Telematics, ICOST 2017	2017	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
Not Article	[No author name available]	16th IFIP WG 6.11 Conference on e-Business, e-Services, and e-Society, I3E 2017	2017	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
Not Article	[No author name available]	16th International Conference on Human-Computer Interaction, HCI 2014	2014	Communications in Computer and Information Science
Not Article	[No author name available]	17th International Conference on Smart Living and Public Health, ICOST 2019	2019	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
Not Article	[No author name available]	18th International Conference on Smart Homes and Health Telematics, ICOST 2020	2020	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)

Not Article	[No author name available]	1st International Conference on Advances in Emerging Trends and Technologies, ICAETT 2019	2020	Advances in Intelligent Systems and Computing
Not Article	[No author name available]	1st International Summit on Internet of Things, IoT360 2014	2015	Lecture Notes of the Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering, LNICST
Not Article	[No author name available]	2013 International Conference on Materials, Mechanical and Manufacturing Engineering, IC3ME 2013	2014	Advanced Materials Research
Not Article	[No author name available]	2nd International Conference on Key Engineering Materials and Computer Science, KEMCS 2013	2013	Advanced Materials Research
Not Article	[No author name available]	3rd International Conference on Internet of Things Technologies for HealthCare, HealthyIoT 2016	2016	Lecture Notes of the Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering, LNICST
Not Article	[No author name available]	3rd International Conference on Interoperability in IoT, InterIoT 2017 on conjunction with 4th International Conference on Safety and Security in Internet of Things, SaSeIoT 2017	2018	Lecture Notes of the Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering, LNICST
Not Article	[No author name available]	4th International Joint Conference on Ambient Intelligence, AmI 2013	2013	Communications in Computer and Information Science
Not Article	[No author name available]	6th International Conference on Information and Communication Technologies for Ageing Well and e-Health, ICT4AWE 2020	2021	Communications in Computer and Information Science
Not Article	[No author name available]	9th International Conference on Smart Homes and Health Telematics, ICOST 2011	2011	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)
Not Article	[No author name available]	EMPATHY 2020 - Proceedings of the 1st International Workshop on Empowering People in Dealing with Internet of Things Ecosystems, co-located with International Conference on Advanced Visual Interfaces, AVI 2020	2020	CEUR Workshop Proceedings
Not Article	[No author name available]	International Conference on Electronic Engineering and Information Science, ICEEIS 2014	2014	Advanced Materials Research
Not Article	[No author name available]	International Conference on Inventive Computation and Information Technologies, ICICIT 2021	2022	Lecture Notes in Networks and Systems
Not Article	[No author name available]	Proceedings of the IADIS International Conference e-Health 2013, EH 2013, Part of the IADIS Multi Conference on Computer Science and Information Systems 2013, MCCSIS 2013	2013	Proceedings of the IADIS International Conference e-Health 2013, EH 2013, Part of the IADIS Multi Conference on Computer Science and Information Systems 2013, MCCSIS 2013
Not Article	[No author name available]	Studies in Health Technology and Informatics	2016	Studies in Health Technology and Informatics
Relevant	Elvira Amador-Domínguez, Emilio Serrano, Daniel Manrique, Juan F. De Paz	Prediction and Decision-Making in Intelligent Environments Supported by Knowledge Graphs, A Systematic Review		
Relevant	Xieling Chen, Gary Cheng, Fu Lee Wang, Xiaohui Tao, Haoran Xie, Lingling Xu	Machine and cognitive intelligence for human health: systematic review		
Relevant	Hasan Sapci A., Aylin Sapci H.	Innovative assisted living tools, remote monitoring technologies, artificial intelligence-driven solutions, and robotic systems for aging societies: Systematic review	2019	JMIR Aging
Relevant	Pal D., Funilkul S., Charoenkitkarn N., Kanthamanon P.	Internet-of-Things and Smart Homes for Elderly Healthcare: An End User Perspective	2018	IEEE Access
Irrelevant	Amelie Gyrard, Antoine Zimmermann, Amit Sheth	Building IoT based applications for Smart Cities: How can ontology catalogs help?	2018	IEEE Internet of Things Journal

Relevant	Xiaoci Huang, Jianjun Yi, Xiaomin Zhu, Shaoli Chen	A Semantic Approach with Decision Support for Safety Service in Smart Home Management		
Relevant	Chuan-Jun Su, Chang-Yu Chiang	IAServ: An Intelligent Home Care Web Services Platform in a Cloud for Aging-in-Place	2013	
Relevant	José Antonio Sánchez Alcón, Lourdes López, José-Fernán Martínez, Gregorio Rubio Cifuentes	Trust and Privacy Solutions Based on Holistic Service Requirements	2015	
Relevant	Ayan Chatterjee, Andreas Prinz, Martin Gerdes, Santiago Martinez	An Automatic Ontology-Based Approach to Support Logical Representation of Observable and Measurable Data for Healthy Lifestyle Management: Proof-of-Concept Study		
Relevant	Hubert Kenfack Ngankam, Hélène Pigot, Dominique Lorrain, Isabelle Viens, Sylvain Giroux	Context awareness architecture for ambient-assisted living applications: Case study of nighttime wandering		
Relevant	Federica Paganelli, Emilio Spinicci, Dino Giuli	ERMHAN: A Context-Aware Service Platform to Support Continuous Care Networks for Home-Based Assistance		
Relevant	Andrzej Bialas	Computer-Aided Sensor Development Focused on Security Issues	2016	
Irrelevant	Gregorio Rubio, José Fernán Martínez, David Gómez, Xin Li	Semantic Registration and Discovery System of Subsystems and Services within an Interoperable Coordination Platform in Smart Cities		
Relevant	Shaker El-Sappagh, Farman Ali, Abdeltawab Hendawi, Jun-Hyeog Jang, Kyung-Sup Kwak	A mobile health monitoring-and-treatment system based on integration of the SSN sensor ontology and the HL7 FHIR standard	2019	
Relevant	Xiaoliang Meng, Feng Wang, Yichun Xie, Guoqiang Song, Shifa Ma, Shiyuan Hu, Junming Bai, Yiming Yang	An Ontology-Driven Approach for Integrating Intelligence to Manage Human and Ecological Health Risks in the Geospatial Sensor Web		
Relevant	Wenquan Jin, Do Hyeun Kim	Design and Implementation of e-Health System Based on Semantic Sensor Network Using IETF YANG		
Relevant	Asad Masood Khattak, Wajahat Ali Khan, Zeeshan Pervez, Farkhund Iqbal, Sungyoung Lee	Towards A Self Adaptive System for Social Wellness	2016	
Relevant	Thanassis Mavropoulos, Spyridon Symeonidis, Athina Tsanousa, Panagiotis Giannakeris, Maria Rousi, Eleni Kamateri, Georgios Meditskos, Konstantinos Ioannidis, Stefanos Vrochidis, Ioannis Kompatsiaris	Smart integration of sensors, computer vision and knowledge representation for intelligent monitoring and verbal human-computer interaction		
Irrelevant	Giorgos Bamparopoulos, Evdokimos Konstantinidis, Charalampos Bratsas, Panagiotis D. Bamidis	Towards exergaming commons: composing the exergame ontology for publishing open game data		
Relevant	Femke Ongenae, Jeroen Famaey, Stijn Verstichel, Saar De Zutter, Steven Latré, Ann Ackaert, Piet Verhoeve, Filip De Turck	Ambient-aware continuous care through semantic context dissemination		
Relevant	Davide Calvaresi, Jean-Paul Calbimonte	Real-Time Compliant Stream Processing Agents for Physical Rehabilitation	2020	
Relevant	Teresa Garcia-Valverde, Andrés Muñoz, Francisco Arcas, Andrés Bueno-Crespo, Alberto Caballero	Heart Health Risk Assessment System: A Nonintrusive Proposal Using Ontologies and Expert Rules		

Relevant	Fabio Vergari, Tullio Salmon Cinotti, Alfredo D'Elia, Luca Roffia, Guido Zamagni, Claudio Lamberti	An Integrated Framework to Achieve Interoperability in Person-Centric Health Management		
Relevant	Hicham Ajami, Hamid Mcheick, Karam Mustapha	A Pervasive Healthcare System for COPD Patients	2019	
Relevant	Yang Liu, Boon-Chong Seet, Adnan Al-Anbuky	Ambient Intelligence Context-Based Cross-Layer Design in Wireless Sensor Networks		
Relevant	Xingsi Xue, Junfeng Chen	Optimizing Sensor Ontology Alignment through Compact co-Firefly Algorithm		
Relevant	Alberto G. Salguero, Macarena Espinilla, Pablo Delatorre, Javier Medina	Using Ontologies for the Online Recognition of Activities of Daily Living		
Relevant	Luca Cattelani, Pierpaolo Palumbo, Luca Palmerini, Stefania Bandinelli, Clemens Becker, Federico Chesani, Lorenzo Chiari	FRAT-up, a Web-based Fall-Risk Assessment Tool for Elderly People Living in the Community	2015	
Irrelevant	Bin He, Sylvia E. Perez, Sang Han Lee, Stephen D. Ginsberg, Michael Malek-Ahmadi, Elliott J. Mufson	Expression profiling of precuneus layer III cathepsin D-immunopositive pyramidal neurons in mild cognitive impairment and Alzheimer's disease: Evidence for neuronal signaling vulnerability		
Relevant	Carlos Fernando Crispim-Junior, Alvaro Gómez Uría, Carola Strumia, Michal Koperski, Alexandra König, Farhood Negin, Serhan Cosar, Anh Tuan Nghiem, Duc Phu Chau, Guillaume Charpiat, Francois Bremond	Online Recognition of Daily Activities by Color-Depth Sensing and Knowledge Models		
Relevant	Jin Liu, Yunhui Li, Xiaohu Tian, Arun Kumar Sangaiah, Jin Wang	Towards Semantic Sensor Data: An Ontology Approach		
Relevant	David Anton, Idoia Berges, Jesús Bermúdez, Alfredo Goñi, Arantza Illarramendi	A Telerehabilitation System for the Selection, Evaluation and Remote Management of Therapies	2018	
Irrelevant	Giada Graziana Genchi, Andrea Degl'Innocenti, Chiara Martinelli, Matteo Battaglini, Daniele De Pasquale, Mirko Prato, Sergio Marras, Giammarino Pugliese, Filippo Drago, Alessandro Mariani, Michele Balsamo, Valfredo Zolesi, Gianni Ciofani	Cerium Oxide Nanoparticle Administration to Skeletal Muscle Cells under Different Gravity and Radiation Conditions		
Irrelevant	Zhaoyu Zhai, José-Fernán Martínez Ortega, Néstor Lucas Martínez, Pedro Castillejo	A Rule-Based Reasoner for Underwater Robots Using OWL and SWRL	2018	Sensors
Relevant	Nekane Larburu, Richard G. A. Bults, Marten J. Van Sinderen, Ing Widya, Hermie J. Hermens	An Ontology for Telemedicine Systems Resiliency to Technological Context Variations in Pervasive Healthcare		
Relevant	Todor Ivaşcu, Viorel Negru	Activity-Aware Vital SignMonitoring Based on a Multi-Agent Architecture		
Irrelevant	Mohamad Arafah, Paolo Ceravolo, Azzam Mourad, Ernesto Damiani, Emanuele Bellini	Ontology based recommender system using social network data		
Relevant	John K. Zao, Tchin-Tze Gan, Chun-Kai You, Cheng-En Chung, Yu-Te Wang, Sergio José Rodríguez Méndez, Tim Mullen, Chieh Yu, Christian Kothe, Ching-Teng Hsiao, San-Liang Chu, Ce-Kuen Shieh, Tzyy-Ping Jung	Pervasive brain monitoring and data sharing based on multi-tier distributed computing and linked data technology		
Irrelevant	Eman K. Elsayed, Kamal A. ElDahshan, Enas E. El-Sharawy, Naglaa E. Ghannam	Reverse engineering approach for improving the quality of mobile applications		

Relevant	Alia El Bolock, Slim Abdennadher, Cornelia Herbert	An Ontology-Based Framework for Psychological Monitoring in Education During the COVID-19 Pandemic		
Irrelevant	Tom Sear	Xenowar dreams of itself		
Irrelevant	Rubina Ghazal, Ahmad Kamran Malik, Basit Raza, Nauman Qadeer, Nafees Qamar, Sajal Bhatia	Agent-Based Semantic Role Mining for Intelligent Access Control in Multi-Domain Collaborative Applications of Smart Cities		
Irrelevant	Athanasia Warnecke, Jennifer Harre, Matthew Shew, Adam J. Mellott, Igor Majewski, Martin Durisin, Hinrich Staecker	Successful Treatment of Noise-Induced Hearing Loss by Mesenchymal Stromal Cells: An RNAseq Analysis of Protective/Repair Pathways		
Irrelevant	Zi-jian Ni, Lili Rong, Ning Wang, Shuo Cao	Knowledge model for emergency response based on contingency planning system of China		
Irrelevant	Shaker El-Sappagh, Daehan Kwak, Farman Ali, Kyung-Sup Kwak	DMTO: a realistic ontology for standard diabetes mellitus treatment		
Irrelevant	Jean-François Ethier, François Goyer, Paul Fabry, Adrien Barton	The Prescription of Drug Ontology 2.0 (PDRO): More Than the Sum of Its Parts		
Irrelevant	Vikas Gupta, April D Estrada, Ivory Blakley, Rob Reid, Ketan Patel, Mason D Meyer, Stig Uggerhøj Andersen, Allan F Brown, Mary Ann Lila, Ann E Loraine	RNA-Seq analysis and annotation of a draft blueberry genome assembly identifies candidate genes involved in fruit ripening, biosynthesis of bioactive compounds, and stage-specific alternative splicing		
Irrelevant	Shahensha Shaik, Elizabeth C. Martin, Daniel J. Hayes, Jeffrey M. Gimble, Ram V. Devireddy	Transcriptomic Profiling of Adipose Derived Stem Cells Undergoing Osteogenesis by RNA-Seq		
Irrelevant	Humaira Arshad, Saima Abdullah, Moatsum Alawida, Abdulatif Alabdulatif, Oludare Isaac Abiodun, Omer Riaz	A Multi-Layer Semantic Approach for Digital Forensics Automation for Online Social Networks		
Irrelevant	Panagiotis Kasnesis, Nicolaos-Alexandros Tatlas, Stelios A. Mitilineos, Charalampos Z. Patrikakis, Stelios M. Potirakis	Acoustic Sensor Data Flow for Cultural Heritage Monitoring and Safeguarding		
Irrelevant	Yulin Dai, Ruifeng Hu, Astrid Marilyn Manuel, Andi Liu, Peilin Jia, Zhongming Zhao	CSEA-DB: an omnibus for human complex trait and cell type associations		
Irrelevant	Douglas M. Bowden, Evan Song, Julia Kosheleva, Mark F. Dubach	NeuroNames: An Ontology for the BrainInfo Portal to Neuroscience on the Web		
Irrelevant	Mohammed Odeh, Faten F. Kharbat, Rana Yousef, Youusra Odeh, Dina Tbaishat, Nancy Hakooz, Rana Dajani, Asem Mansour	iOntoBioethics: A Framework for the Agile Development of Bioethics Ontologies in Pandemics, Applied to COVID-19		
Irrelevant	Patricia L Whetzel, NCBO Team	NCBO Technology: Powering semantically aware applications		
Irrelevant	Tasnimul Alam Taz, Kawsar Ahmed, Bikash Kumar Paul, Fahad Ahmed Al-Zahrani, S M Hasan Mahmud, Mohammad Ali Moni	Identification of biomarkers and pathways for the SARS-CoV-2 infections that make complexities in pulmonary arterial hypertension patients		
Irrelevant	Victor Zeng, Cassandra G. Extavour	ASGARD: an open-access database of annotated transcriptomes for emerging model arthropod species		
Irrelevant	Jonathan Schug, Sharon Diskin, Joan Mazzarelli, Brian P. Brunk, Christian J. Stoeckert, Jr.	Predicting Gene Ontology Functions from ProDom and CDD Protein Domains		
Irrelevant	Marijke Broekhuis, Lex van Velsen	Improving usability benchmarking for the eHealth domain: The development of the eHealth		

		UsaBility Benchmarking instrument (HUBBI)		
Irrelevant	Shaadi Mehr, Aida Verdes, Rob DeSalle, John Sparks, Vincent Pieribone, David F Gruber	Transcriptome sequencing and annotation of the polychaete <i>Hermodice carunculata</i> (Annelida, Amphinomididae)		
Irrelevant	Shur-Jen Wang, Stanley J F Laulederkind, Yiqing Zhao, G Thomas Hayman, Jennifer R Smith, Monika Tutaj, Jyothi Thota, Marek A Tutaj, Matthew J Hoffman, Elizabeth R Bolton, Jeffrey De Pons, Melinda R Dwinell, Mary Shimoyama	Integrated curation and data mining for disease and phenotype models at the Rat Genome Database		
Irrelevant	Ummul Hanan Mohamad, Mohammad Nazir Ahmad, Youcef Benferdia, Azrulhizam Shapi'i, Mohd Yazid Bajuri	An Overview of Ontologies in Virtual Reality-Based Training for Healthcare Domain		
Irrelevant	Kerry E. Poppenberg, Kaiyu Jiang, Michael K. Tso, Kenneth V. Snyder, Adnan H. Siddiqui, John Kolega, James N. Jarvis, Hui Meng, Vincent M. Tutino	Epigenetic landscapes suggest that genetic risk for intracranial aneurysm operates on the endothelium		
Irrelevant	Cecilia Reyes-Peña, Mireya Tovar, Maricela Bravo, Regina Motz	An ontology network for Diabetes Mellitus in Mexico		
Irrelevant	Saneyoshi Ueno, Grégoire Le Provost, Valérie Léger, Christophe Klopp, Céline Noiro, Jean-Marc Frigerio, Franck Salin, Jérôme Salse, Michael Abrouk, Florent Murat, Oliver Brendel, Jérémy Derory, Pierre Abadie, Patrick Léger, Cyril Cabane, Aurélien Barré, Antoine de Daruvar, Arnaud Couloux, Patrick Wincker, Marie-Pierre Reviron, Antoine Kremer, Christophe Plomion	Bioinformatic analysis of ESTs collected by Sanger and pyrosequencing methods for a keystone forest tree species: oak		
Irrelevant	Shaogui Guo, Jingan Liu, Yi Zheng, Mingyun Huang, Haiying Zhang, Guoyi Gong, Hongju He, Yi Ren, Silin Zhong, Zhangjun Fei, Yong Xu	Characterization of transcriptome dynamics during watermelon fruit development: sequencing, assembly, annotation and gene expression profiles		
Irrelevant	Binjie Cheng, Jin Zhang, Hong Liu, Meiling Cai, Ying Wang	Research on Medical Knowledge Graph for Stroke		
Irrelevant	Arthur Lackner, Said Fathalla, Mojtaba Nayyeri, Andreas Behrend, Rainer Manthey, Sören Auer, Jens Lehmann, Sahar Vahdati	Analysing the evolution of computer science events leveraging a scholarly knowledge graph: a scientometrics study of top-ranked events in the past decade		
Irrelevant	Clayton Shoppa	Heidegger's Forgetfulness of Difference		

**Included Articles**

Article Title	Year
Ontology Alignment: First Step towards Voice Control for Smart-Home Assistive Scenarios	2024
A multi-domain ontology on healthy ageing for the characterization of older adults status and behaviour	2023
IoT and health monitoring wearable devices as enabling technologies for sustainable enhancement of life quality in smart environments	2023
Ontological Model for Cohesive Smart Health Services Management	2023
IoT Ontology Development Process for Well-Being, Aging and Health: Challenges and Opportunities	2023
DOMUS: a domestic ontology managed ubiquitous system	2022
Never Alone: a Quality of Context-aware Monitoring System for Aging in Place Smart Home	2022

Towards ontology-based requirements engineering for IoT-supported well-being, aging and health	2022
A semantic-enabled and context-aware monitoring system for the internet of medical things	2021
Activity-Aware Vital SignMonitoring Based on a Multi-Agent Architecture	2021
An Automatic Ontology-Based Approach to Support Logical Representation of Observable and Measurable Data for Healthy Lifestyle Management: Proof-of-Concept Study	2021
Knowledge Engineering Framework for IoT Robotics Applied to Smart Healthcare and Emotional Well-Being	2021
Smart integration of sensors, computer vision and knowledge representation for intelligent monitoring and verbal human-computer interaction	2021
Fuzzy ontology based activity recognition for assistive health care using smart home	2020
Real-Time Compliant Stream Processing Agents for Physical Rehabilitation	2020
A mobile health monitoring-and-treatment system based on integration of the SSN sensor ontology and the HL7 FHIR standard	2019
A Pervasive Healthcare System for COPD Patients	2019
An ontology-based healthcare monitoring system in the internet of things	2019
Knowledge-based architecture for recognising activities of older people	2019
Smart home based prediction of symptoms of alzheimer's disease using machine learning and contextual approach	2019
A Telerehabilitation System for the Selection, Evaluation and Remote Management of Therapies	2018
Activity Recognition for Anomalous Situations Detection	2018
An Ontology-Driven Approach for Integrating Intelligence to Manage Human and Ecological Health Risks in the Geospatial Sensor Web	2018
Design and Implementation of e-Health System Based on Semantic Sensor Network Using IETF YANG	2018
Semantic and dweller-based decision support system for the reconfiguration of domestic environments: RecAAL	2018
Using Internet of Things and biosensors technology for health applications	2018
Using Ontologies for the Online Recognition of Activities of Daily Living	2018
Customization of domestic environment and physical training supported by virtual reality and semantic technologies: A use-case	2017
Designing smart living for ageing Alice—and the persons next door	2017
A foundational ontology-based model for human activity representation in smart homes	2016
A Semantic Approach with Decision Support for Safety Service in Smart Home Management	2016
Computer-Aided Sensor Development Focused on Security Issues	2016
Ontology-based context aware for ubiquitous home care for elderly people	2016
SOnAr: Smart Ontology activity recognition framework to fulfill semantic web in smart homes	2016
Towards A Self Adaptive System for Social Wellness	2016
A Context-Aware Interactive Health Care System Based on Ontology and Fuzzy Inference	2015
Cloud semantic-based dynamic multimodal platform for building mhealth context-aware services	2015
U-Health Smart system architecture and ontology model	2015
An ontology-based approach to ADL recognition in smart homes	2014
Heart Health Risk Assessment System: A Nonintrusive Proposal Using Ontologies and Expert Rules	2014
IAServ: An Intelligent Home Care Web Services Platform in a Cloud for Aging-in-Place	2013
An ontology-enhanced SOA-based home integration platform for the well-being of inhabitants	2012
Anticipating health hazards through an ontology-based, IoT domotic environment	2012
Ontological framework of context-aware and reasoning middleware for smart homes with health and social services	2012
An Integrated Framework to Achieve Interoperability in Person-Centric Health Management	2011
Implementing evidential activity recognition in sensorised homes	2011
POSTECH's U-health smart home for elderly monitoring and support	2010
ERMHAN: A Context-Aware Service Platform to Support Continuous Care Networks for Home-Based Assistance	2008