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The Role of an Architect in Creating the Image of an Elderly-Friendly Sustainable Smart City

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Abstract: The idea of sustainable smart city has extensive scientific literature where the architects' role in designing built environments, being a physical platform for implementing "elderly-friendly" solutions, is poorly referenced. The main objective of the article is to define the role of architects in creating the image of sustainable smart cities, focusing on senior citizens. The paper surveys the available literature on the subject and describes pilot studies carried out at the indicative level among the students of one of architecture faculties in Poland, based on the design thinking method. The studies demonstrate how students imagine intelligent elderly-friendly cities in the future from the architects' perspective. In addition, examples of other studies with the students of that faculty are presented. Following the analyses combining the conclusions of research and pilot studies with the students, a tabular summary of the architects' tasks and roles were provided—these were divided into six building blocks of a smart city and as a reference to the elements shaping the image of cities, districts and buildings. This is a new, innovative classification of architectural issues. The perspectives for further desk research and field participatory research were indicated, which should, in the future, translate into a novel holistic approach to the problem.

Keywords: sustainable smart city; architect; image of the city; participatory design; body of the building; facades; roofs; built environment; design thinking method

1. Introduction

The sustainable development of cities is one of the key challenges of the modern world. There are authors who believe that smart cities are just an example of another concept of the ideal city [1,2]. It should be also noted that, in the literature, the concepts of sustainable city and smart city are sometimes investigated separately. Thomas L. Saaty and Pierfrancesco De Paola treat the sustainable city, smart city and compact city as separate models. According to the authors—taking into account the process of urban sprawl, the transformation of buildings and economic impact on the environment—the choice of a compact city model is the best solution for future urban design and planning [3]. Alessio Russo and Giuseppe T. Cirella point out that the features of a modern compact city support sustainable development [4]. In turn, Matthew E. Kahn claims that the improvements of information technology, and advances in the know-how on the reduction of pollution, and following it health benefits for residents imply that more cities will be striving for "smart" sustainable development [5]. Such a viewpoint is presented in the present paper.

A sustainable smart city is an interdisciplinary concept, and as such, it has many definitions, emphasizing various aspects and proposing different assessment indicators [6]. An attempt to systematize the concepts existing in that area was made by Mattias Höjer and Josefin Wangela [7], and [8], as well as Rasha F. Elgazzar and Rania F. El-Gazzar [9]. The latter of the aforementioned authors has been extensively discussing and clarifying the meaning of the words/concepts such as "smart", "sustainability", "sustainable development", and also the meaning of complex concepts such as "sustainable cities", "smart cities" and "smart sustainable cities". They also quote the definition of smart sustainable cities developed by the focus group on smart

sustainable cities adopted in October 2015 by the International Telecommunication Union (ITU—T Study Group 5), which reads as follows: "A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve the quality of life, efficiency of urban processes and services, as well as competitiveness ensuring at the same time that that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects" [10].

The above definition represents a holistic character of the reflections on sustainable smart cities. In the discussion on such a concept of urban development, the following notions are taken into account: "sustainability, quality of life, urban aspects, and the main topics comprise: society, economy, environment, and governance" [6]. As it was mentioned above, the knowledge about sustainable smart cities was created by the representatives of various scientific disciplines, who often worked in interdisciplinary teams and describe the problem from various perspectives, such as: social [11,12], economic [13], information technology (IT) and telecommunications [14–16], environmental [17], health [18–21], legal [22], transport and mobility [23,24], urban and spatial planning [25,26], etc. It should be emphasized that the recurring feature of the publications is that they do not concentrate on the discussion of one problem, but they show it in a broader context (therefore, the above pairing of the authors with a given aspect only informs that a given topic occurs in a given publication). The market offer involving the segmentation of the smart city is dedicated to an even wider group of recipients, including:

- "local government officials: presidents and mayors of cities, village mayors,
- directors and heads of investment departments (roads, cubature investments),
- management staff of municipal companies (heating plants, combined heat and power plants, city cleaning, road management),
- representatives of the private sector (developers, investors, designers)" [27].

In the vast and diverse group of stakeholders, the architectural aspect, and the role of an architect in the development of sustainable smart cities, are getting lost. For example, in the above-mentioned, very comprehensive report [6] (pp. 6–7), the Table presents the definitions of "sustainable smart cities", assigning keywords to each of them. Further, there is no keyword of "architecture" among them. A very indirect reference can be seen in the definitions quoted below:

- "Hitachi's vision of a smart sustainable city seeks to show concern for the global environment and lifestyle safety and convenience through the coordination of infrastructure. Smart sustainable cities realized through the coordination of infrastructures consist of two infrastructure layers that support consumers' lifestyles together with the urban management infrastructure that links these together using information technology (IT)" [28];
- "Replacing the actual city infrastructures is often unrealistic in terms of cost and time. However, with recent advances in technology, we can infuse our existing infrastructures with new intelligence. By this, we mean digitizing and connecting our systems, so they can sense, analyze and integrate data, and respond intelligently to the needs of their jurisdictions. In short, we can revitalize them so they can become smarter and more efficient. In the process, cities can grow and sustain quality of life for their inhabitants" [29];

Furthermore, in the document of the Economic Commission for Europe Committee on Housing and Land Management [30] (pp. 7–9), from among the mentioned 72 smart sustainable city indicators, only the following ones have indirect reference to architecture:

- "Topic: Physical infrastructure—buildings;
- Indicator: Integrated management in public buildings" [30]
- "Topic: Environmental quality:
- Indicator: Perception on environmental quality
- Indicator: Green areas and public spaces" [30].

The problem of overlooking architectural issues when considering sustainable cities was noted by Emile Mardacana who pointed out that, "The definition of a smart city based on six key smart elements, including economy, management, people, science and technology, life and the environment, ignores such a basic component as the built environment, which is a physical platform of a smart city" [31]. To provide an example, we can refer to publication [32], in which each of the six pillars (building blocks of a smart city) was assigned from 10 to 22 features. In the presented set there was only one, very general reference to architecture, in the context of the latest research conducted by universities "for cultural heritage, architecture, planning, development, and the like" [32], (p. 13). Therefore, it should be noted that: "Architecture is all around us. From our homes to our offices, our stations to our skylines, the built environment defines the world we live in [33]". It should be added here that even the concept of "smart city architecture" has been taken over by computer science and it does not apply to the built environment, but to the structure of software [34]. In turn, in the literature on the subject of architecture and urban planning, even if there are problems at the intersection of architecture and sustainable development and smart city technology, the authors focus on environmental or technological aspects, and the reference to architectural aspects is missing. Architecture appears only in general keywords such as "smart buildings" and "urban infrastructure", but with no specific information, for example, how the idea of sustainable smart city translates into the form or facades of buildings. Furthermore, yet the environment of sustainable smart cities is designed by architects in terms of usability, but also in terms of form. Architects provide a physical form for the entire ecosystem of solutions created by smart and sustainable residential houses, smart and sustainable public utility buildings, which in turn create smart and sustainable housing districts [35]. In this way, the external image (appearance) of architecture is created, which in turn translates into the image of districts and cities together with their recreation and rest spaces furnished with small architecture. On this point, it should be noted that the literature on the subject includes a few publications referring to a more general level, i.e., to the urban form of smart cities [36]. Yet, the image at the architecture level, i.e. the form of buildings, facades, roofs, details and what is happening in the space around these buildings—in terms of the development of sustainable smart cities has not been a popular research topic so far.

This particular aspect - the external image of sustainable smart cities and the role of the architects in their creation—is discussed in the article. It is the main objective. Furthermore, the indirect objective of the article involves the synthesis of knowledge and an attempt to define the elements of sustainable smart cities, whereof a designing process is within the competence of the architect. Due to the extensive subject matter, the article provides a limited scope of analyses, attempting to define the elements that shape the image of a sustainable, senior friendly city, and to identify the role of an architect in this context. We must add that in line with the accepted assumption, an elderly-friendly city should be understood as one that meets the following criteria set by WHO:

- "it takes into account the diversity of older people,
- it prevents exclusion and promotes the contribution of seniors to all areas of life,
- it respects the choices, decisions and way of life of older people,
- it anticipates and flexibly responds to the needs of people growing old" [37].

The world and Polish resources of scientific publications contain works that combine the issues of smart cities and senior-related issues in the following aspects:

- security [37],
- intelligent technologies offering amenities for seniors [38],
- models of city management allowing for the role of people aged 65+ as a creative class [39],
- implemented amenities for seniors [40],
- a system for collecting and managing data on daily routines of seniors [41],
- problems of seniors in urban areas, mainly in terms of transport [42],
- technological skills and computer competences of seniors [43],
- very general recommendations, also in relation to the built environment [44].

At that stage of research, when searching through the resources of scientific publications published in the open access, as journals, books or conference proceedings, no scientific publication could be found that would combine the following aspects:

- issues of sustainable smart cities,
- senior issues,
- architectural issues.

It seems that this may be a new approach to research problems.

It should be clearly emphasized that due to the presumed novelty of the undertaken topic, the research is in the initial phase, referred to as the indicative level. It consists in observation and general review on the investigated topic, during which we can identify some dependencies, but without diagnosing their origin. The rise to higher levels, i.e.;

- investigative (application of scientific methods, an attempt to explain the problem and its cause) and;
- diagnostic ones (comparative tests that diagnose and indicate recurring problems that should be eliminated) [45],

requires in-depth research using scientific methods, techniques and research tools.

Thus, the paper:

- sums up only a certain scope of knowledge, recommending that further desk researches should be carried out,
- shows a sample of new research, with the participation of students of the Faculty of Architecture of the Silesian University of Technology,
- quotes research studies conducted earlier in which students of the Faculty of Architecture of the Silesian University of Technology also participated,
- indicates further research directions, placing them in Tables related to six building blocks of a smart city, which seems to be an unprecedented form of classification of architectural problems.

As to the scope of the work, it should be added that due to the scope of the undertaken topic and that of the article, we had to omit some relevant and interesting issues, such as:

- examples of smart and sustainable buildings, districts and cities friendly to seniors worldwide and in Poland (a catalog of good practices),
- various types of reports, guides, guidebooks, guidelines for the implemented innovations in the senior-friendly built environment,
- online platforms dedicated to the subject of smart cities, constituting the basis of current information on the programs being implemented,
- social (e.g., exclusion, isolation) and medical context (various forms of physical and intellectual disability of seniors) that can affect the perception of the architectural environment.

These issues will be the subject of further research and publications.

2. Materials and Methods

Nowadays, architects propose solutions not found before and they use technological novelties to create innovative building concepts. It is the first of the architects' roles: creating innovative building concepts which make use of technological achievements and presenting them in attractive visualizations and films used to promote the idea of sustainable smart cities.

Of course, only a few architects become famous innovators and visionaries. Despite this, a lot of emphasis is put on the development of creativity in the education process of architects at the Silesian University of Technology in Gliwice (Poland) [46]. As an example, we can provide a study conducted

by the author of the article with second-cycle students at the Faculty of Architecture. The topic was formulated as follows: "How will seniors be participating in the life of a future smart city (in the perspective of 10 years) and what amenities will it be offering them?" It combined two very important issues, i.e., the problem of designing a friendly space for seniors and the problem of a smart city.

The layout of the research work is presented in Figure 1. It shows the duality of the research approach, which has been also demonstrated in the structure of the article, i.e., the "gray path" (on the left) presents the pilot study with the participation of students, and the "blue" path (on the right) presents the expert research documented by the author's own publications, which are listed in the bibliography. Both sources combine to obtain the synthesis of knowledge.

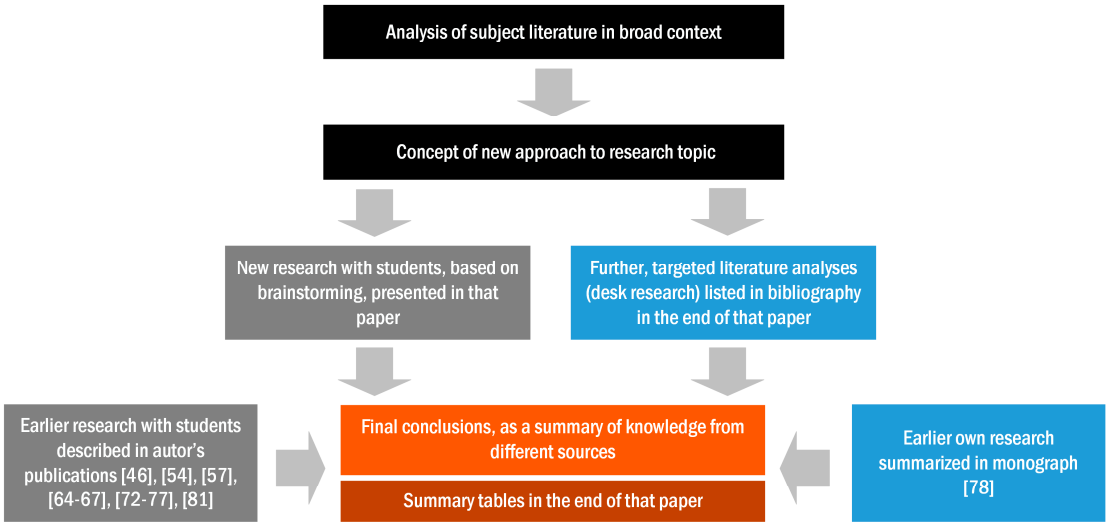

Figure 1. Layout of research procedures used in the article. It refers to the indicative level and illustrates the author's pursuit of the synthesis of knowledge and holistic approach to the investigated problem, i.e., "the role of the architect in creating the image of a sustainable smart city friendly to seniors" (author's own study).

The study was conducted in two groups of 12 students, which were then divided into teams of 4. In total, 24 students divided into 6 teams took part in the study. It should be noted that the first group had in-depth knowledge of the needs of the elderly, acquired during the previous research studies. This research concerned a different topic and was conducted under the guidance of Anna Szewczenko [47], associated professor an expert in the field of architectural solutions friendly to seniors. In the course of the study, the group developed, among others, "personae" or characteristics of fictitious people of senior age, who were given names, their health condition was described, scenarios of their functioning and spending free time was conceived, including passions and interests, as well as their social roles, fears and worries. The "personae" characterized in this way were used in the further part of the study described here. The second group of students had only general knowledge in the field of senior related issues.

The scientific objective of the research was to find out the vision of future architects about the life of seniors in a smart city of the future in the perspective of 10 years, and to collect inspiring, innovative ideas. The study had also a didactic goal—stimulating students' creativity, familiarizing them with brainstorming techniques and sensitizing future architects to the problems of older people in cities of the future. The study was conducted using brainstorming, which is an important element of the design thinking method. According to the definition of Willemien Visser: "Design Thinking refers to design-specific cognitive activities that designers apply during the process of designing" [48]. Items explaining design thinking principles are presented in the following publications:

- Brown, T. "Change by Design. How Design Thinking Transforms Organizations and Inspires Innovation" [49],

- Brown, T., "Design thinking" [50],
- Eleutheriou, V.; Depiné, Á.; de Azevedo, I.; Teixeira, C. "Smart Cities and Design Thinking: sustainable development from the citizen's perspective" [51],
- Thoring, K., Müller, R. M., "Understanding Design Thinking: a process model based on method engineering" [52],

Examples involving the application of Design Thinking in the discipline of architecture and urban planning, are presented in the following articles:

- Stangel, M., Witeczek, A., "Design thinking and role-playing in education on brownfields regeneration. Experiences from Polish-Czech cooperation" [53];
- Tymkiewicz, J.; Bielak-Zasadzka, M. "The design thinking method in architectural design, particularly for designing senior homes" [54];
- Stangel, M., Szóstek, A., "Empowering citizens through participatory design: a case study of Mstów, Poland" [55].

The brainstorming was carried out with a classic division into two stages (as shown in Table 1):

- in the first stage, the students freely submitted ideas and wrote them down on post-it notes (with the provision that there were no restrictions on self-expression and no criticism);
- in the second stage, the students looked at the results written on the notes, discussed them and tried to select ideas that in their opinion suited them best.

The collection of ideas for each of the partial topics took five minutes. Ideas were written on post-it notes and stuck on boards assigned to each team.

During the brainstorming the students were to imagine that in 10 years, cities would change, becoming smart cities. There was an auxiliary research question related to this was: "What facilities for seniors represented by the three "personae" should be found in the smart city in the future?" It was clearly emphasized that the smart city had evolved since the creation of that concept—from smart city 1.0 focused on technology to human smart city 4.0 focused on people [56]. Importantly, the problem was to be considered by the students from the architect's perspective.

The diagram of the research methodology (Figure 2) and Table 1 presents the scenario of the research below.

Table 1. Research scenario with the participation of students of the Faculty of Architecture of the Silesian University of Technology involving the following research problem: "How will seniors be participating in the life of a future smart city (in the perspective of 10 years) and what amenities will it be offering them?".

Introduction to research		Duration
organizational activities	• selection of team leaders and compiling the students into particular groups; • explaining the course of research;	2 min
information explaining the undertaken research problem	• reading out the definition of a smart city by the leader and a brief explanation of its development stages; • reading out the characteristics of the three "personae" prepared earlier by students—potential residents / users of a smart city representing the following age ranges: 60–65 years, 71–75 years and 81–85 years; • short discussion, answers to questions;	10 min

Table 1. *Cont.*

	Introduction to research	Duration
	Brainstorming part 1–unrestrained presentation of ideas	
brainstorming problem_1	• urban information,	55 min in total
brainstorming problem_2	• communication and transport - public and individual,	
brainstorming problem_3	• forms of residential housing,	
brainstorming problem_4	• accessibility of buildings,	
brainstorming problem_5	• availability of services,	
brainstorming problem_6	• medical services (as city-wide service),	
brainstorming problem_7	• ensuring safety,	
brainstorming problem_8	• recreation and free time,	
brainstorming problem_9	• new urban functions,	
brainstorming problem_10	• ecology and sustainable development,	
brainstorming problem_11	• aesthetics and the appearance of buildings and urban space,	
	Brainstorming part 2: summary and conclusions.	
analysis of ideas	• brief discussion and the evaluation of ideas, • selection of the best solutions, • summary and conclusions.	10 min

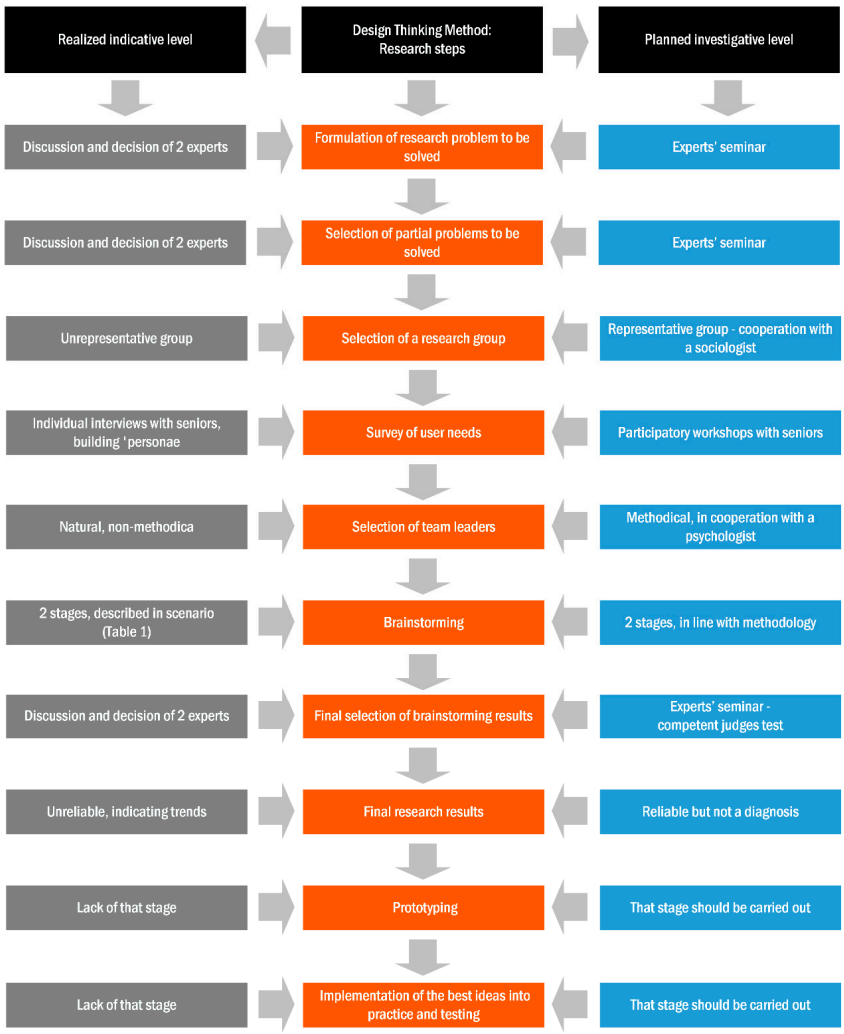

Figure 2. Diagram of the research methodology presents the design thinking method step by step (red path). Additional explanations are presented on left and right side. On the right (grey path) you can see how research activities have been realized on indicative level, and on the right (blue path)—how it should be conducted on investigative level, when the full design thinking methodology in cooperation with sociologist and psychologist should be applied.

3. Results

As presented in Figure 2, the research at the indicative level was conducted on an unrepresentative group, and therefore its results could not be generalized, as they refer only to the opinion of the group participating in the research. In the future, the study can be repeated in cooperation with sociologists, which will allow to select a methodologically correct research sample and to make the generalization of results. It seems that brainstorming in terms of the number of generated ideas is an effective method [46,57]. In the study, 24 people submitted 348 ideas on a given topic within 55 min. The team working most effectively in terms of quantity generated 70 ideas, and the smallest number of ideas submitted by a 4-person team was 42. The situation was different when assessing to the quality of the generated ideas. The ideas which satisfied the key condition of the research, i.e., a reference to architecture, could be assessed as rather conservative, and replicating what is known from reality. They are quoted and discussed below.

3.1. Results of Research

The results of the research will be discussed merely as some tendencies in the formulation of answers to the stated research problem.

3.1.1. Urban Information

With regard to urban information, the students proposed "information points as urban accents in stopover places; horizontal signs—arrows, changing surface textures for the blind; simple, legible and consistent visual messages; maps of the city with our location; city districts identified by colors; avoiding excessive visual information on digital displays; avoiding sound reverberation, echo, understandable information transfer (in relation to hearing)"; as part of the "smart" solutions, the idea of "a communication assistant: senior robot" was proposed.

3.1.2. Communication and Transport-Public and Individual

In the field of communication and public or individual transport, the following was proposed: "roofed, lit, closable stops (protection against wind), with ergonomic seats and places for shopping bags, walking sticks, crutches, walkers, pets; moving walkways in popular public places, or quiet traffic paths separated from faster traffic paths (separating people being in a hurry from people who walk)"; in the area of "smart" solutions, the idea of "drones distributing mail or medicines ordered from the pharmacy" was proposed.

3.1.3. Forms of Residential Housing

The proposed forms of housing for seniors in a smart city are identical to the already existing solutions: "old age homes connected to an orphanage or kindergarten (preventing loneliness), multi-generational housing estates; ground floors for seniors, multifunctional facilities, a residential complex containing services, medical and entertainment functions; community centers, gardens for common cultivation; common areas; places encouraging intergenerational integration; all flats should be flexible (for able-bodied and disabled people); color marking of buildings-better orientation; elevators, ramps in every building; senior cohousing"; "smart" solutions comprise: "fingerprint-activated door opening; flats equipped with buttons to activate assistance (neighborly, medical)".

3.1.4. Accessibility of Buildings

In the field of building accessibility, students reported conservative ideas such as: "no architectural barriers; clear marking of entrances; designing kitchen systems which are mobile and adapted for people in wheelchairs (e.g., the possibility of rolling the wheelchair under the worktop)", and more audacious ones: "antigravity domes, teleporting; mobile buildings".

3.1.5. Availability of Services

The availability of services would be ensured by: "a large number of benches in the infrastructure of public space; stops along the routes of seniors; appropriate functional zoning; creating interactive community work centers for seniors (earning money); creating special senior zones in stores (lower shelves, wider passageways); activation of seniors with children and with animals"; the ideas for "smart" solutions include: "mobile shops in housing estates for the elderly; shopping via mobile applications with home delivery; automatic shopping assistant (a robot); drones for seniors (a shop); self-cooking and self-cleaning robots; printing of clothes".

3.1.6. Medical Services (as City-Wide Services)

With regard to medical services, the students indicated a number of solutions which are currently regarded as technological novelties, namely: "a symptoms-interpreting machine (in bed); artificial intelligence at home as a physician; a hologram and interactive meetings with specialist doctors; individual medical scanners". The students did not in any way refer those technological proposals to the solutions in the field of architectural space in which they would be applied.

3.1.7. Ensuring Safety

The ideas offered by the students on security issues for seniors in a smart city were as follows: "urban lighting with a motion sensor; robotic guards on the street, transhumanism and technological implants to improve the fitness of seniors". The students overlooked the issue of spatial morphology, which has a significant impact on safety. It is not only about the visibility of areas for surveillance cameras, but it also involves the elimination of places in terms of spaces which are conducive to crime [58,59]. Recently, the problem of counteracting terrorism has been added, which is also reflected in urban space projects [60]. This problem was not perceived by the students.

3.1.8. Recreation and Free Time

In the next subtopic "recreation and free time", there were repeated proposals that had been made earlier-regarding the activation and integration of seniors into society (social gardens, activities with children), and only the following was added: "prestigious loges for seniors in cultural institutions; attractive meeting centers for seniors; a larger number of senior architecture points, e.g., graduation towers"; the "smart" solutions involved: "VR (Virtual reality) walking, safe boxes where walking is possible in optimal conditions (temperature, humidity, wherever you want)".

3.1.9. New Urban Functions

With respect to new urban functions, the students once again proposed traditional solutions, some of which are already known: "city markets, where you can sell your products (fruit, vegetables, crafts, art); milk bars (places with cheap food); community and intergenerational cafes and workshops; training places for the elderly in the field of interactive services (IT); intergenerational dialogue centers; spaces for exchanging skills and passing on traditions; drama series cinemas for seniors; mutual reading parlors (for the poor sighted)"; the "smart" ideas included: "modern agora: a random selection of topics related to real problems, and brainstorming ideas for their solutions; Flyspot salons (wind tunnels) for people with mobility difficulties—stimulation of movement".

3.1.10. Ecology and Sustainable Development

In the described study, ecology and sustainable development were a separate partial problem. The submitted ideas contained individual references to important problems, such as: energy ("cheap, ecological heating, energy sources; power stations for seniors for electricity/energy generation; personal, garden, public solar umbrellas; solar clothing"), pollution ("cleaning air in every house"); waste ("self-segregation of wastes; biodegradable packaging; eco-medicines"); green infrastructure ("gardens

in housing estates—mini vegetable farms, orchards; sensory gardens for the activation of seniors; less paved surfaces and more greenery"). Yet, there is a feeling of paucity about the above ideas, both in terms of quantity and the lack of more inquisitive insight into the problem in the context of architecture.

3.1.11. Aesthetics and the Appearance of Buildings and Urban Space

In regards to the aesthetics and appearance of buildings and urban space in a smart city friendly to seniors, the students attached great importance to wayfinding issues, proposing such solutions as: "urban functions-characteristic and easy to recognize; automatic signaling informing about the location of, e.g., the entrance zone; cleaning up visual information, in particular from advertising; clear description of streets and districts; identification of individual residential buildings-color-coded staircases and building entrances; murals—characteristic and acceptable". They also reported the need "to keep the spaces open, to maintain private and semi-private areas; to use calm colors; bright, well-lit rooms; natural materials, cozy interiors and balconies, and to use balustrades that give a sense of security, not fear." All in all, the ideas were very conservative, already known and rather ordinary. More innovative and "smart" thinking was represented by such ideas as: "personalized building facade-automatic signaling sensors; goggles-lenses that allow you to adjust the style of the facade to your taste; paint that changes color; changing eco-facades made of nanorobots".

4. Discussion

When analyzing the research results, we could observe that it was quite difficult for students to relate the problems of designing a smart city friendly to seniors to architecture. It seems that it was also difficult for them to empathize with the role of an architect in this aspect. There were no differences in the quality of the submitted ideas in any of the groups (the level was very even). The image of the city of the future emerging from the students' brainstorms was not futuristic, but real, while the proposed "smart" solutions were frequently not associated with architecture. There were several inspiring ideas, but also ideas that dangerously approached the exclusion or stigmatization of seniors as a social group (separate pavements, separate zones in shops, robotic guards on the streets). On the positive side, it should be noted that students pay attention to extremely important issues: ergonomics, accessibility of buildings and space for everyone, wayfinding and the need for places of social integration. Yet, there were no proposals to solve such important issues as: climate change and what it means for architecture. In addition, the problems of environmental pollution or waste utilization were treated marginally, although they can be very creatively related to architectural design. As an example, we can refer to the heat and power waste-to-energy plant building in Amager, Copenhagen (Denmark), designed by the Bjarke Ingels Group architectural office. This facility proves that innovations in the field of architecture are possible. In the film "BIG Architecture" [61], Bjarke Ingels passionately described how the concept of this—in principle, very utilitarian building—was being developed. It was known that it would be a large cubature, towering over the surroundings. Then, during the brainstorming, the idea of a "mountain building" with a ski slope was proposed. In this way, an incinerator was created, producing electricity and energy, producing more water than it consumes, with a sloping roof, on which a year-round "artificial ski slope, hiking slope and climbing wall" were created [62]. The problem of the chimney, which had to be placed on the body of the building, was also attempted to be solved from the architect's point of view: it was supposed to emit smoke (because it could not be eliminated), but in the shape of circles (smoke rings) [63]. In that way, the most desirable features in the contemporary architecture had been combined: innovation for the benefit of the environment and people. Such innovative ideas directly relating to architectural design, relating to buildings: to their outer shells, roofs, facades, functions and needs of the natural environment and people were definitely missing among the ideas submitted by the students.

When analyzing the above results of the study, it is worth referring to two earlier studies conducted by the author with the participation of the students of the Faculty of Architecture. The first study concerned the notion of students about retirement homes for seniors in the future (but more distant

future, when they are seniors themselves). In this case, the full design thinking methodology was used with prototyping in various ways. The results of the research were more satisfying in terms of the innovation of the proposed solutions. The description of the research and the results were published in the articles of Joanna Tymkiewicz and Maria Bielak-Zasadzka [54,64].

The second of the related studies only indirectly concerned the subject of this article, i.e., the image of sustainable smart cities and the role of the architect in shaping them. In this case, students - young architects faced the following research question: "Would everyone want to live in futuristic-looking buildings?" Young people probably would, but would seniors too? Such doubts arose from the conclusions of the pilot studies regarding, "The evaluation of facade solutions and their impact on the aesthetic quality of the external image of buildings" (2016). The multithreaded scientific and didactic project was realized in cooperation of the Faculty of Architecture with the University of the Third Age in Gliwice and the Laboratory of Architecture 60+ Foundation (Lab 60+). As part of the research, a focus meeting was arranged with seniors who were asked to express their opinions on various aesthetic solutions for the facades of residential buildings intended for the elderly. The examples of such buildings were presented on large photographs and slides. The course of the research and the conclusions have been described in the publications [65,66]. It turned out that seniors criticized the façades of buildings developed in an avant-garde way. Of course, the research was not conducted on a representative group and the results are not authoritative, but for reference, it is worthwhile quoting some examples of seniors' opinions about the highly rated by architects Home for Elderly People in Alcácer do Sal, Portugal (Aires Mateus Arquitectos, 2010), the finalist of the "European Union Prize for Contemporary Architecture—Mies van der Rohe Award 2013". They read as follows: "it looks good in the picture, but it is not for living", "cubist shape, too modern", "an unsightly box, a block" [66]. In the quoted studies—in the further creative part of the workshop with seniors, some assumptions regarding the aesthetics and functionality of façade solutions had been developed. They favored the tendencies advocating "moderation, traditional aesthetic solutions, friendly scale of buildings, natural materials". Favorite elements of the façade comprised "large, shared terraces with the opportunity of socializing, intimate balconies, fenced off from one another, but in a way ensuring contact with neighbors" [66]. These completely preliminary guidelines inspire further, in-depth research on this topic and allow us to conclude that if cities of the future are to be focused on people and their needs, and seniors are becoming an increasing part of the society, facade solutions must be consulted with them, and the public should be educated to enhance the understanding and acceptance of innovative, novel and avant-garde solutions—also in terms of aesthetics. Here, architects have a lot of scope to act: as educators, convincing to new architectural solutions and as the liaison between various groups of stakeholders (e.g., between investors and users).

This role of architects is associated with another one—initiating and conducting pre-project participatory research in which representatives of future, potential users would take part. An example of this type of research carried out by the author with the participation of students can be illustrated by the venture, "The Experimental Project on 'Soft' Intervention Aimed at Enlivening the Academic Zone" (2017). The said research project aimed to gather ideas from the academic community to revive the newly designed campus space of the Silesian University of Technology in Gliwice (Figure 3). The research was described and published in the article [67]. We can also add here that among many offered proposals, there were also ones that would certainly improve the image of the academic district in terms of space characterized by the "sustainable" and "smart" features which take into account the needs of people with disabilities. In the project, one of the student teams proposed for the academic district a network of elements improving the functionality and accessibility of the campus using the so-called small architecture and information technology. The network of connections would consist of: pylons with interactive information, an application, typhlographic signs, i.e., tactile information for the blind and a 3D campus model, as well as multifunctional boxes. The boxes would offer: "a charging station for electric carts/wheelchairs, wireless charging of mobile phones, access to electricity from renewable sources, access to Wi-Fi and to academic library resources, a working

station for a student, a place for books, available through the application". The box would be equipped with "devices used to read the resources of digital library, e.g., a tablet, e-book reader, and it would ensure access to the equipment for listening to music files, as well as to the text-to-speech software. The information would be also written in Braille." Such solutions would facilitate the use of the boxes for the visually impaired and hearing impaired. The elements of the concept were presented in the article [67], (p. 29). In that case, the students-future architects played a triple role: researchers, potential users and designers. The presented student concept fits into a frequently adopted strategy which says that smart solutions should be first implemented in a city quarter or district, and not in the whole city. In this aspect, the academic campus is a very good place to initiate smart solutions, with the care for sustainable development [68].

Figure 3. Fragment of the central part of the space of the academic campus of the Silesian University of Technology in Gliwice (Upper Silesia, Poland), as of today (photograph taken by J. Tymkiewicz).

In this article, we have already mentioned the architects' role in designing the image of elderly-friendly sustainable smart cities. These are roles which are located on two opposite poles and which define two attitudes of the architect: as an innovator-visionary (1) as well as a researcher and educator (2). The tasks reflecting these two attitudes are as follows:

1. setting the direction of development, creating new ideas, visions, innovations in the field of the architecture of sustainable smart cities that are not always possible to implement, using the achievements of science and technology as well as digital technologies (architect innovator-visionary);
2. initiating and carrying out pre-project participatory research allowing to diagnose the real needs of users, and developing guidelines for design works, which take into account such needs; conducting research on buildings and urban spaces which expand knowledge on their functioning (architect-researcher); educating the society (including senior citizens) on new solutions (architect-educator).

The above roles should be supplemented with the most important one, being in the middle and combining both of the above roles, namely: designing the image of cities which implement the idea of elderly-friendly sustainable smart city in real conditions. Cities are currently struggling with the problems mentioned at the beginning of this article, i.e., the increasing number of inhabitants, including seniors, energy consumption and environmental pollution, and the consequences of climate change. Cities have also the potential contained in the development of digital technologies that allow them to diagnose and to some extent solve the mentioned problems. Architects, through their designs and implementations supply a form for the conceptual solutions pertaining to the above problems. They also create a physical space for virtual digital technologies (e.g., for various types of applications) that are supposed to make life easier for users (including the elderly) living in the real built environment. The number of applications proposed for residents is constantly increasing. A review of the European classification of smart city applications has been presented in the article [69]. In addition, in Polish cities various types of "smart" and "sustainable" as well as "pro-senior" applications have already been implemented as, e.g., "active senior card", mobile navigation for visually impaired people, and a smart public transport system [70,71].

There are many more implemented solutions, but is the real world, or the built environment, following the development of the virtual world? The above systems and applications operate in city spaces representing different qualities. On the one hand, these are organized, architecturally valuable, historical or modern city centers. Their attractive image is consistent with the image of a city aspiring to the title of "smart" and "sustainable". But in the same city there are also neglected, devastated districts, or developing districts-but in a chaotic way. Even if there are applications or other smart facilities operating in such places, it is difficult to feel the idea of sustainable smart city. There is an unpleasant gap between technological advancement in the virtual world and low quality of the real world. What is missing is the appropriate quality of the built environment mentioned at the beginning, as a physical platform for implementing the idea of smart city in a sustainable way. There is also no deeper reflection on the design projects being implemented in the field of "smart" and "sustainable" and no reference to architecture.

It seems that an architect-designer should not only use elements of the language of global architecture of sustainable smart cities (listed in Chapter 2), but also take into account real problems of cities (including local problems), buildings and the needs of their users, as well as legal regulations and economic potential. It is too early to make conclusions and summarize the discussed topic as well as to start discussion with other researchers. More research is needed, but now we can at least create a list of tasks related to the role of the architect in shaping the image of a sustainable smart city. They comprise such elements: outer shells/bodies of buildings, facades with details, roofs, and urban spaces in their vicinity (such as: recreational areas, squares, etc.). The diagnosed tasks and roles have been presented in a tabular form, taking into account the division into six building blocks of a smart city (the division has been taken from the already cited publication [32] (pp. 12–16)). It should be added that the partial problems presented below have in many cases been already investigated, but only as general problems, without reference to the issues of designing sustainable smart cities friendly to seniors. For some of them—examples of bibliographic references were given as the nucleus of desk studies. A broader approach requires further literature review and in-depth analyses. At this stage, we could state that knowledge is dispersed and there is a need to consolidate it.

The photographs below are presenting facades and public spaces as the architectural elements of image of Gdańsk—the city in Poland, which develops the idea of an elderly-friendly sustainable smart city (Figures 4–8).

Figure 4. Gdańsk—Museum of the Second World War, main façade (photograph taken by J. Tymkiewicz).

Figure 5. Gdańsk—Old Town District (photograph taken by J. Tymkiewicz).

Figure 6. Gdańsk—modern facades on the banks of the River Motława (photo by J. Tymkiewicz).

Figure 7. View of public space of the "Forum Gdańsk" (photograph taken by J. Tymkiewicz).

Figure 8. Modern public space of the "Forum Gdańsk" (photo by J. Tymkiewicz).

The following tables (Tables 2–7) contain the content selected and formulated by the author, supported by the author's experience of research carried out for many years on the functions of facade in the holistic aspect, summarized, among others, in the conference proceedings [72,73], articles [74–77], and in the monograph [78]. The tables contain also—students' inspiring ideas for the author, voiced during the brainstorming described in this article.

It was the author's intention that the tables presented below—ordering architectural issues and presenting architects' roles in a new way, analogously to the issue of sustainable smart cities—could become a starting point to undertake research at the investigative and diagnostic levels in this area, focused on the needs of the residents of sustainable smart cities, especially senior citizens.

Table 2. "Smart people"—in the context of the architect's role in designing the image of a sustainable smart city (author's study).

Tasks in designing the image of a sustainable smart city	Role of architect
Identifying users' needs prior to the designing work (pre-design studies);	researcher
Consulting architectural projects with the local community in terms of the body and facades of buildings, and offering conclusions that are taken into account in the design process (participatory design);	researcher, liaison between different stakeholder groups
Educating the society and persuading to new innovative solutions so that they are understood and accepted;	educator
Creating attractive places in the city (urban spaces and / or buildings) in the "human scale", having good proportions, serving as places of social integration, centers of creativity and activity of residents, where meetings, workshops, brainstorming can take place, for example: "city markets, where you can sell your products (fruit, vegetables, crafts, art); milk bars (places with cheap food); community and intergenerational cafes and workshops; training places for the elderly in the field of interactive services (IT); intergenerational dialogue centers; spaces for exchanging skills and passing on traditions; drama series cinemas for seniors; mutual reading parlors (for the poor sighted)"*;	designer
Respecting the opinions of residents and using the ideas and innovative solutions they propose in the designing process;	designer
Integrating universities with the city and designing them in such a way so that the buildings evoke positive emotions, so that they do not intimidate, but in a friendly way invite residents to want to stay there and learn throughout their lives;	educator
Designing in the way ensuring that architectural solutions prevent the exclusion of specific social groups and are friendly to all user groups (design for all, "no architectural barriers; clear marking of entrances", "automatic signaling informing about the location of, e.g., the entrance zone" *, universal design);	designer

* The ideas generated during the brainstorming described in the article.

Table 3. "Smart economy" in terms of the role of the architect in designing the image of a sustainable smart city (author's study).

Tasks in designing the image of a sustainable smart city	Role of architect
Designing visually attractive, avant-garde buildings that have the potential to become tourist attractions affecting the economic development of the city (Bilbao effect);	visionary and designer
Designing buildings which have the shapes which exclude natural ventilation, air-conditioned, with windows which do not open /facades only in places where it is economically justified (buildings maintained from the budget often have problems, because the costs of air conditioning are too large for them) [78,79];	designer and researcher
Designing architecturally impressive double-skin facades only in places where it is economically justified and the facade can be an efficiently functioning element of the building's ventilation system which does not generate substantial costs;	designer and researcher

Table 3. *Cont.*

Tasks in designing the image of a sustainable smart city	Role of architect
Designing facades as one of the building layers, with shorter durability than the structure (building life cycle analysis), and thus easily replaceable after the period of technical or aesthetic wear [80];	designer
Designing façades with the appropriate proportions of glazed surfaces, thanks to which natural lighting of the interior will be provided, without additional costs of illuminating it with artificial light during the day;	designer
Incorporation of sunshade systems (the most effective are external ones) into the architectural design of the facade, which can reduce the costs of air conditioning of the interior and improve the comfort of users [78,81];	designer
Proposing "green facades" and "green roofs" only in places where the owner can afford the costs of their maintenance (infrastructure, gardening services, water, fertilizers, etc.);	designer
In the design of greenery, choosing native species that grow and develop well in the climate and conditions prevailing in the area and require minimal irrigation and fertilization (which generates additional costs) [4];	designer
In the design of facades, taking into account the economic aspects of electricity consumption in night light scenography and by media facades [82];	designer

Table 4. "Smart mobility" in terms of the role of the architect in designing the image of a sustainable smart city (author's study).

Tasks in designing the image of a sustainable smart city	Role of architect
Designing buildings and building complexes with good proportions, in human scale, harmoniously fitting into the existing architectural and urban context, with interesting facades, respecting cultural values, emphasizing the identity of the place and genius loci ("Smart heritage" [83], space morphology [4]), with active ground floor services ("ground floors for seniors" *), roofed arcades—which encourages walking and supports the mobility of residents (pedestrian-friendly cities);	designer
Integrating the city's green infrastructure into a network of connections, which facilitates the creation of interesting walking and cycling routes, not only in green areas, but also along architecturally attractive frontages, or through interesting urban interiors;	designer
Designing facades—hallmarks, city icons that support orientation in space (wayfinding);	visionary, designer
Designing buildings and safe spaces, well-lit and having a form which supports their monitoring and security, but also ensures privacy (where it is desirable), with a friendly appearance that encourages residents to walk [84,85];	designer
Interesting design of the space around stops, stations, underground passages, good graphic signage (also for blind or visually impaired people)—as elements supporting pedestrian traffic;	designer
"roofed, lit, closable stops (protection against wind), with ergonomic seats and places for shopping bags, walking sticks, crutches, walkers, pets""cleaning up visual information, in particular from advertising; clear description of streets and districts" *;	

* The ideas generated during the brainstorming described in the article.

Table 5. "Smart environment" in terms of the role of the architect in designing the image of a sustainable smart city (author's study).

Tasks in designing the image of a sustainable smart city	Role of architect
Parametric designing, which takes into account various factors affecting the shape of building body and facades, such as wind (aerodynamics of the body, alleviation of drafts, but also ensuring good ventilation of building interiors and urban interiors), sun (insolation, shading, overheating of interiors, glare caused by reflected light), noise (specific forms of the façade can strengthen or weaken sound waves), snow (build-up on roofs and sloping facades) [86,87];	designer
Taking into account a place for the infrastructure related to new technologies in the architectural design so that it does not disturb the aesthetics of the facade or roof;	designer

Table 5. *Cont.*

Tasks in designing the image of a sustainable smart city	Role of architect
The use of ecological materials, but taking into account all aspects of the problem, including production, transport, durability and disposal;	designer
Integrating renewable energy sources with building facades (photovoltaic cells are more real, and wind turbines are less real) and educating the public in this respect;	designer, educator
Designing the arrangement of solar panels and/or solar collectors on roofs in such a way that they do not spoil the aesthetics of the building (e.g., additional mounting frames protruding above the roofs);	designer

Table 5. *Cont.*

Tasks in designing the image of a sustainable smart city	Role of architect
Designing greenery on facades—including: -local atmospheric conditions (in Polish conditions, these are not technologically advanced vertical gardens like Patrica Blanca's designs, but rather climbing plants resistant to weather conditions), -real advantages (CO_2 absorption and oxygen production, absorption of pollutants), -and disadvantages (moisture retention and possible destruction of wall surfaces if climbing plants do not climb along suitable support frames);	designer
Designing vegetable or herb gardens on roofs, or separate buildings adapted for cultivation, so-called urban farming; designing "gardens in housing estates—mini vegetable farms, orchards; sensory gardens for the activation of seniors" *	designer, visionary
Preventing the formation of "urban heat islands"—wherever possible, preservation of the existing plant cover in design projects: lawns, trees and shrubs; "a larger number of senior architecture points, e.g. graduation towers"*	designer
In the design of greenery, careful selection of plant species, taking into account the local ecosystem and the danger of its disturbance by the introduction of new, invasive species (currently a fashionable trend is to give up mowing grass in cities, which saves energy, reduces the amount of exhaust from mowers, allows to create an "urban meadow");	researcher, designer
In the design projects, taking into account underground waste collection and segregation systems which do not spoil the aesthetics of the city;	designer

* The ideas generated during the brainstorming described in the article.

Table 6. "Smart living" in terms of the architect's role in designing the image of a sustainable smart city (author's study).

Tasks in designing the image of a sustainable smart city	Role of architect
Designing so that people, their needs, health, well-being and satisfaction from being in the built environment are always in the center; architecture (also through its image) should support human development and people's activity throughout their entire life;	researcher, designer
In the design of green infrastructure of the city, taking into account the impact of plants on human health; the positive aspect is represented by medicinal plants, herb gardens, therapeutic horticulture, sensory gardens; negative impact involves pollen shedding harmful to allergy sufferers, the presence of insects dangerous for health (ticks, mosquitoes) [4];	designer
Including elements liked by users in facade designs, such as terraces and balconies, properly protected from the sun, ensuring very desirable privacy to residents (properly selected distances between balconies, and balcony covers), but also providing a visual connection between the interior and the outside [81];	designer

Table 6. *Cont.*

Tasks in designing the image of a sustainable smart city	Role of architect
Conducting pre-project studies—research on the perception of the facade by residents, taking into account the impact of new technologies and social media [88]—the assessment of what facade solutions (detail, color, texture, composition of facade elements) are accepted by the residents and best express the ambition, development and creativity of the local community;	researcher, designer
Establishing cooperation with artists, and integrating art with architecture (e.g., murals—"characteristic and acceptable" *, permanent or temporary installations) sending out a message: this place is inhabited by creative people;	designer, liaison between different stakeholder groups
Including a graphic information system in the facade design that is friendly to the elderly and to people with disabilities;"information points as urban accents in stopover places; horizontal signs—arrows, changing surface textures for the blind; simple, legible and consistent visual messages; maps of the city with our present location; city districts identified by colors; avoiding excessive visual information on digital displays"*	designer
Designing media facades, taking into account the nuisance that they can generate for nearby residents (pulsating light);	designer
The presence of the infrastructure in the design projects related to the availability of buildings and space (lifts, ramps, ground floors accessible from ground level), building entrances easy to find, panes (in shop windows or doors) properly marked to avoid collisions; compliance with the principles of universal design;	designer

* The ideas generated during the brainstorming described in the article.

Table 7. "Smart governance" in terms of the role of the architect in designing the image of a sustainable smart city (author's study).

Tasks in designing the image of a sustainable smart city	Role of architect
Undertaking participatory research to define the features of the building's form and facade (e.g., a government building), which can evoke desired associations that reflect the idea of a sustainable smart city, e.g., intelligence, respect for nature, ecology, modernity, creativity, efficient management, democracy, openness to citizens;	researcher and designer
Designing facades that correctly inform about the purpose of the building (denoting the function of the object), evoking positive emotions and connotations [89]; "urban functions—characteristic and easy to recognize"*;	designer
Anticipating advertising space and city information displays in façade designs—not disturbing the city's aesthetics;	designer

*The idea generated during the brainstorming described in the article.

5. Conclusions

The above elements presented in the tables are not, "in principle", smart, but they can successfully create a "physical" sustainable built environment, oriented on human needs (including the needs of seniors), which can be entwined by a network of "virtual" connections, offering various "smart" facilities. Such a more "analogue" approach should prevent the exclusion of some social groups, e.g., seniors due to their lower proficiency in the digital world, or poorer citizens—due to insufficient access to new technologies (e.g., smartphones). The most important role of an architect in this context is:

- the role of a designer,
- the role of a visionary
- the role of a researcher,
- the role of an educator,
- the role of a liaison between different stakeholder groups.

Creating innovative ideas, but also researching and recognizing user needs, reliable, knowledge-based co-creation and co-designing with local communities, educating and persuading to new solutions—these are the architect's main roles and tasks in the context of contemporary challenges of the architecture of elderly-friendly sustainable smart cities. The undertaken topic is very broad and the content presented is only a voice in the discussion on the development of modern cities and the role of the architect in this aspect. The list of tasks involving the creation of an image anew is certainly not closed. It presents a holistic approach and may be the nucleus of further in-depth research on each constituent. In the future, it could provide an opportunity to develop design guidelines for architects, indicating at the same time their important role, which has been so far insufficiently exposed in the designing process of elderly-friendly sustainable smart cities.

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