

Aleksander Nicał (a.nical@il.pw.edu.pl)

Division of Production Engineering and Construction Management, Faculty of Civil Engineering, Warsaw University of Technology

## OUTLOOK FOR THE IMPLEMENTATION OF SELECTED AMBIENT ASSISTED LIVING CONCEPTS FOR PANEL BUILDING

### PERSPEKTYWY WDROŻENIA WYBRANYCH KONCEPCJI AMBIENT ASSISTED LIVING DO BUDOWNICTWA WIELKOPŁYTOWEGO

#### Abstract

The paper presents an outline of the concept of Ambient Assisted Living that facilitates the daily functioning of elderly people living in panel buildings erected in the years 1970–1985. It describes the main assumptions of the concept and existing programs to support its implementation. The paper also contains characteristics and percentage share of the most popular building panel systems used in the construction process of residential buildings in Poland. Additionally, selected facilities for the elderly people in flats as well as the possibility of remodelling them for the installation of proposed bathroom environment, are presented.

**Keywords:** Ambient Assisted Living, panel building, elderly people

#### Streszczenie

W artykule przedstawiono zarys koncepcji „życia wspieranego przez otoczenie” ułatwiającej codzienne funkcjonowanie osobom starszym w obiektach wzniesionych w technologii budownictwa wielkopłytowego zrealizowanego w latach 1970–1985. Opisane zostały główne założenia koncepcji, dotychczasowe oraz programy wspierające jej wdrożenie. Artykuł zawiera także charakterystykę i procentowy udział w budownictwie najbardziej popularnych systemów wielkopłytowych, w jakich wznoszone były budynki mieszkalne w Polsce. Dodatkowo przedstawione zostały wybrane udogodnienia dla osób starszych w mieszkaniach, polegające na zastosowaniu innowacyjnego kompleksowego panelu łazienkowego i możliwości przebudowy mieszkania w tym celu.

**Słowa kluczowe:** Ambient Assisted Living, budownictwo wielkopłytowe, osoby starsze

## 1. Introduction

Construction, like many other sectors of the economy, is vulnerable to all kinds of social changes, including changes in the demographic structure of the country. Despite the continued growth of the world population, particularly intense in the last 40–50 years, in many developed and highly developed countries a decrease in the birth rate is observed. The consequence of these processes is inevitable change in the age structure of the population, resulting in a percentage increase in the population pyramid of the elderly people, generally equal to and exceeding 60 years. At the same time, a decrease in the share of children and young people is noticeable. In Poland, the period of political transformation that began in 1989 has also brought a number of significant changes in the demographic behaviour of the population. This same as in the developed countries of Western Europe, the mortality rate of society has been significantly improved. However, international migration, as well as a lower number of births and marriages and their durability has resulted in a decrease in Poland's population [1]. Such a situation in the long term will lead to the emergence and consolidation of the model of society in which older people are convicted only on their own capabilities. With this in mind, the implementation of technologies for elderly people to function independently seems reasonable to be implemented in Poland. Elderly people, in the large majority, spend a significant part of their time in homes by doing Basic Activities of Daily Living [4] including personal hygiene, dressing, moving around the apartment, the use of bathrooms and toilets. For this purpose, a wide range of solutions for residential buildings, contributing to easier use for the elderly, should be developed under the concept of Ambient Assisted Living. In the history of housing in Poland and the structure of the housing stock, it should be noted that for 30–40 years of building a very large proportion are panel buildings, accounting for up to 78.3% share of other technologies in the 1980s [3]. With high probability it can be assumed that the migration of people living in these buildings, considering the fact that generally these buildings are placed in very favourable locations, mostly in the city centres and districts with well-developed public transport, will not take place. Moreover, the panel buildings are currently being repaired and upgraded, which results in an increase in their usability and aesthetic.

It can be stated without a doubt that the problem of independent living for elderly people will in the near future affect a very large part of the inhabitants of panel buildings. Taking into account the technical parameters of these objects, which are unsuited to current standards, in particular regarding room and corridor width, living space, number and size of lifts, it is necessary to find ways to improve the current situation immediately.

## 2. Concept of Ambient Assisted Living

In order to meet the needs of an aging society, in 2008, the European Parliament and the European Council, on the basis of Article 185 of the Treaty on the Functioning of the European Union, adopted the Common Program of AAL (Ambient Assisted Living) 2008–2013, whose main objective was to stimulate the development of innovative products,

services and systems based on ICT technologies. Among other objectives to be achieved, it planned to:

- ▶ extend the time during which elderly people could live in conditions increasing their independence and mobility;
- ▶ support in maintenance of health and independent living for the elderly;
- ▶ promote a better and healthier life for people at risk,
- ▶ help and support carers, families and caring organizations;
- ▶ boost efficiency and productivity of resources in aging societies [14].

The AAL Joint Programme 2008–2013 is continued by the Active and Assisted Living Programme 2014–2020. Specific classifications of end-users are as follows:

- ▶ **the primary end-user** is the person who is actually using an AAL solution. He/she is considered as a single individual: “the Well-Being Person”;
- ▶ **secondary end-users** are persons or organizations directly in contact with one or more primary end-user(s), such as relatives, friends, neighbours (informal carers), care organizations and their representatives (formal carers);
- ▶ **tertiary end-users** are private or public organizations that are not directly in contact with AAL solutions, but somehow contribute by organizing, enabling or paying for them [10].

### 3. Characteristics of selected panel building systems

The most intensive development of panel building systems in Poland was observed in the period between 1970–1985 (Fig. 1). Due to the favourable technical and economic indicators of the panel building, including lower labour costs and weight of the elements, as well as lower demand for cement, steel and wood in relation to large-block and traditional technology, the panel building systems dominated from the beginning of the 70s in residential buildings.

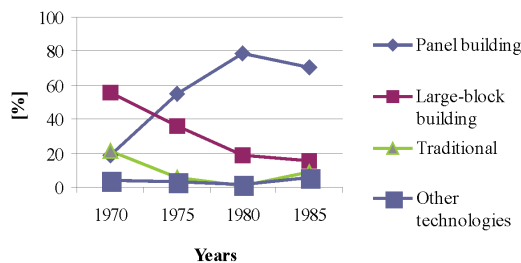


Fig. 1. Chart showing the share of each technology in residential buildings in Poland in the period between 1970–1985 [3]

Panel building technology in Poland was standardized in the following systems:

- ▶ central open standardization based on the unified large-scale element catalogues, forming ranges of prefabricates with a multiple module of 60 cm as a basis. This system allowed the creation of different room layouts in buildings, sections and flats, e.g. W-70, Wk-70;

- ▶ central closed standardization based on a number of typical elements and flat catalogues, enabling creation of a certain number of segments and their configuration in buildings, e.g. OWT-67, OWT-67/N, OWT-75, WUF-T, WUF-75, Szczeciński S-Sz,
- ▶ regional closed standardization based on a number of typical prefabricates and segment catalogues, enabling development of residential complexes in different regions. It consisted of: a) central regional systems, e.g. W-70/SG, W-70/PRAS-BET, Wk-70/SG, WK-70/Z, OWT-67NS, OWT-75NS, WUF-T/K (WUT-80GT), SZCZECIŃSKI S-Sz/SG, b) regional systems, e.g. WWP, RzWP, CzWP, FT/MG, LSM, RBM-75 (OWT-67 version for agriculture) [3].

In terms of usable area, regional standardization systems represent about 20% of the existing panel building systems (Fig. 2).

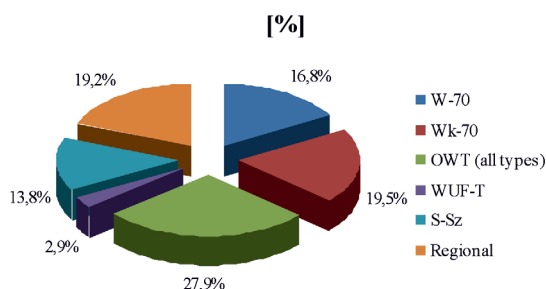


Fig. 2. Chart showing the percentage share of each system in the usable area of panel buildings in Poland in the period between 1970–1985 [3]

Due to the very large number of varieties of regional systems and its relatively small share compared to other panel building systems, the following systems are analysed: W-70, Wk-70, OWT, WUF-T and S-Sz (Tab. 1).

Table 1. Selected panel building systems [3]

System	Basic system parameters [cm]			
	Modular grid	Spacing of structural walls	Bay depth	Storey height
OWT	$n \times 270 \times 480$ $n \times 270 \times 540$	270 and 540	480 and 540	270
WUF-T	$n \times 150 \times 480$	300, 450, 600 and 750	480	270
W-70	$60 \times 60$ (modular) and $60 \times 120$ (planned)	240, 360, 480 and 600	540 and 600	280
Wk-70	$60 \times 60$ (modular) and $60 \times 120$ (planned)	240, 300, 360, 480 and 600	480 and 540	280
S-Sz	$11 \times 240 \times 480$	240 and 480	480 and 540	280

#### 4. Selected concepts for residential facilities

Elderly people usually depend on others and are very often not able to move freely in their apartments, especially if the rooms are not spacious. Unfortunately, panel building systems in the years 1970–1985 were designed on the basis of norms NTP-59 and NTP-74, with limited living area per inhabitant [3].

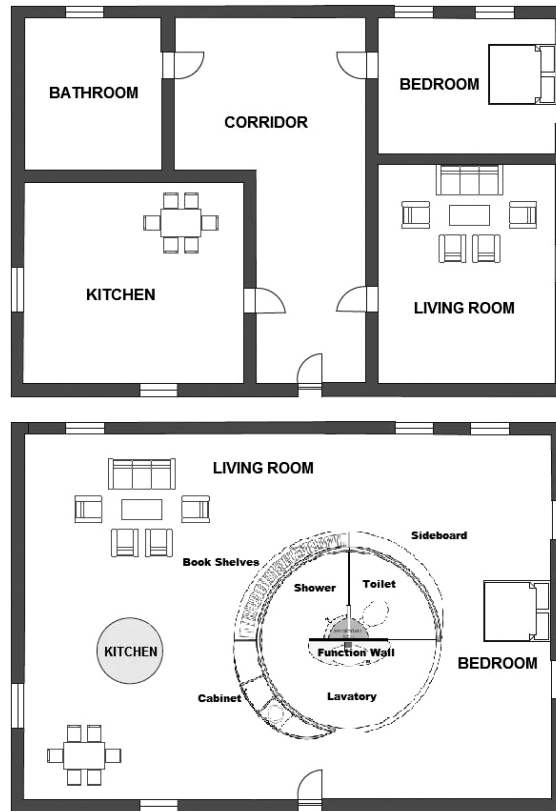


Fig. 3. Barrier-free arrangement of the apartment [2]

Due to narrow corridors, cramped rooms, small kitchens and bathrooms, the apartments, in terms of functional utility, are not suitable for elderly people. The solution in this area shows the concept of the barrier-free apartment arrangement. The idea of this concept is a complete elimination of the partition walls in the apartment. In addition, the concept also combines the bathroom and the kitchen in an integrated bathroom environment (Fig. 3). This bathroom environment panel is divided into 3 sections: a shower room, a toilet and a functional wall with washbasin. The shower room comprises a “bathing machine” that has water nozzles attached to the sides, which spray water as well as shower gel. Integrated blowers dry the user with hot air after showering. The washbasin is height-adjustable like the storage cabinets and

shelves attached to the outer wall [2]. This bathroom environment panel is adapted also for an electric wheelchair and has an adjustable handle to attach it. The wheelchair is resistant to water and can be easily connected to each of the 3 sections. Installation of the panel in the middle of the apartment facilitates its availability; however, attention must be paid to the proper integration of it with all installations. In particular, it is necessary to adjust sanitary water and gas supply, as well as sewer water disposal and ventilation.

Another concept assisting the elderly in assisted living facilities are PAMM Systems (Personal Aids for Mobility and Monitoring), which have been developed in the Field and Space Robotics Laboratory at MIT [11]. The PAMM can be either a cane or walker with a six-axis force-torque sensor mounted under the user's handle to serve as the main user interface. An admittance-based controller integrates the user input signals with the instruction of the schedule based planner, facility map information, and signals from an obstacle avoidance sensor in order to control the system [11]. The device is equipped with an on-board sensor that monitor the user's basic vital signs. The system is connected to a central computer via wireless link so that current information about the health and location of the user can be provided. Thanks to the signposts located on the ceiling of the apartment and the camera, the location of the PAMM is accurately determined (Fig. 4).

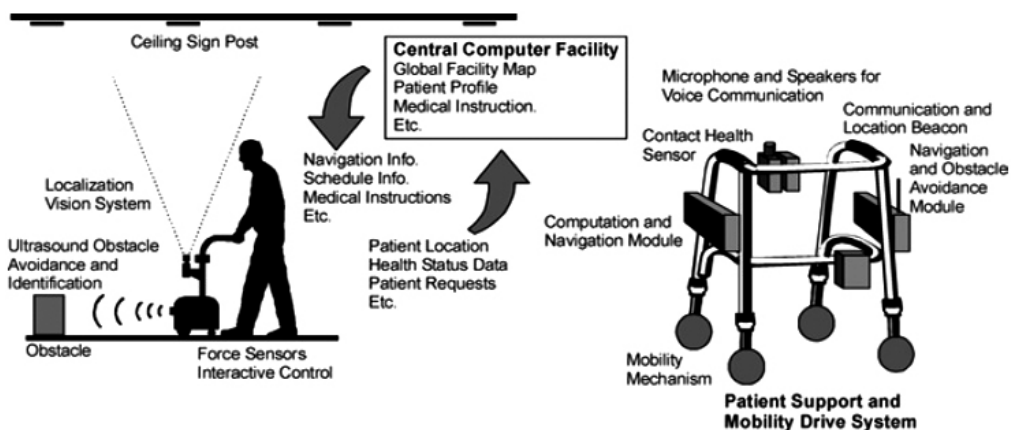


Fig. 4. PAMM system concept [11]

One important issue in constructing robotic walkers and mobile robot base platforms, equipped with two force-sensing handle bars, is shared control. The robot must be capable of providing navigation and guidance while maintaining a natural and predictable motion response [12]. It is essential to bind the control of two systems (an elderly human and a robotic walker) engaged in the task of navigation. Due to the fact that the goals of human and robot may often misalign, the shared control system must determine whether the human or the machine cedes control. The two components enabling shared control are a haptic interface for capturing user intent and control software that binds the two systems [12].

The haptic interface registers the user's intention through physical interaction. The interface transforms the force applied by the user into the robot's motion [12]. The haptic interface is equipped with force sensors, embedded into the handlebar structure of the walker robot. Handlebars are required to support and stabilize the ambulatory devices and should be planned so that the user's hands can grip them firmly. The placement of the force sensors inside the handlebars results in maintaining a steady hold by the user and manipulates the robotic walker in a manner more consistent with contemporary roller-based walkers [12]. An example of the haptic interface is shown in Fig. 5.

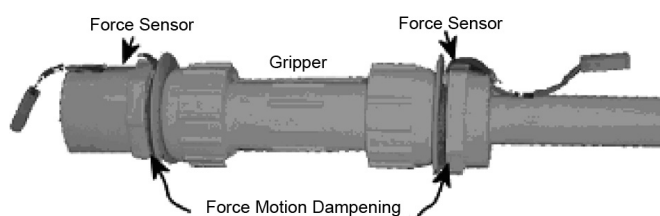


Fig. 5. The haptic interface handlebars [12]

## 5. Conclusions

The problem of an aging society in Poland will become more noticeable in the next few years. The crucial issue will concern ensuring decent living conditions for elderly people that should be understood as free, comfortable and safe performance of all daily activities in the apartment. Further research is needed in this area, in particular the behaviour of the elderly inside their apartments should be analysed, as for example: the time they spend on performing basic activities of daily living, such as washing, dressing, eating, distance covered in the apartment, location of everyday devices,. Additionally, a study concerning the feasibility of adapting the panel buildings to the concept of Ambient Assisted Living must be carried out. Great emphasis should be placed on housing redevelopment issues, especially to the potential removal of structural load-bearing walls and partition walls. Not without significance are issues in the adaptation of sanitary and electrical installations to the assembly of the bathroom environment panel.

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