A Survey of Telecare Systems in Poland

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Abstract: In view of the demographic changes, the need for new telecare technologies is clearly growing. At the same time, in Polish law, there is still no provision allowing for the financing of the telemedicine and telecare services by the National Health Fund. The aim of this contribution is to survey the state-of-the-art telecare systems available on the Polish market and to discuss the main related problems. We also present results of interviews carried out in Social Welfare Centres. It turns out that the telecare system matching most of the identified key needs is not yet available on the Polish market.

1 INTRODUCTION

Statistics of the ageing of our societies are alarming. In 2015 the share of the elderly (75+) in Poland is at roughly 7% of the total, and, according to forecasts, it will increase to 11% in 2030, and to 13.5% in 2045 (GUS, 2015). Furthermore, as predicted within the Health for Growth Programme by the European Commission, in 2020 there will be a shortage of one million health workers in the EU and, should no action be taken, 15% of the necessary care will not be covered. Therefore, Information and Communication Technologies (ICT) solutions are needed to tackle workforce shortages and to maximize the efficiency of the health and care systems.

Hopefully, ICT tools may not only support the functioning of the health and care systems, but also address the proactive needs of the ageing societies to improve the quality of life. The list of the state-of-the-art ambient assisted living solutions is extensive, see (Lara et al., 2013). Artificial intelligence is able to handle and process big data coming from inhomogeneous and uncertain sources including signals retrieved from sensors. Signal analysis and anomaly detection are only some research problems that may be addressed with fast growing machine learning tools, see e.g., (Banaee et al., 2013, Sow et al., 2013, Mannini et al., 2010). An interesting approach to human activity recognition, basing on video recordings and adapting the fuzzy methodology has been proposed by (Díaz-Rodríguez et al., 2014).

The main goal of this contribution is to survey the state-of-the-art telecare systems available on the Polish market and discuss the main related problems. We have investigated them by performing an introductory survey and interviews in Social Welfare Centres. Basing on the performed survey, it turns out that the development of the telecare systems in Poland is significantly slower than generally in Europe. The results of this survey show that the telecare system matching all the identified key needs is neither common nor easily available in Poland, not to mention the fact that it is not freely available or financed with public funds.

It needs to be stated that the focus of this paper is not to provide an exhaustive and systematic review of scientific publications related to the ICT solutions, but rather to survey the telecare systems that are deployed on the Polish market. The national focus of this study is justified by (a) important differences among countries as regards the demographic situations, not only in sheer numbers, but also in family structures and relations; (b) very deep differences in the systems of health and social care; and (c) important differences in wealth of citizens, as well as the capacities of the health and care institutions.

The structure of this paper is as follows. In the next Chapter, we describe the telecare systems available in Poland. In Chapter 3, we describe our

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survey on desired characteristic of a telecare system and discuss the related challenges. Chapter 4 presents conclusions and an outline for future research possibilities.

2 TELECARE SYSTEMS

Among many applications of telemedicine, the telecare system is the most associated with primary care for the patients. The telecare system refers to the automated support of social care at home. It is focused on monitoring the vital signs or potentially harmful situations (e.g. falls, night wandering, flooding with water, smoke, gas) and automatic reporting to the monitoring centre, see e.g. (Tchalla, 2012, Turner and McGee-Lennon, 2013).

2.1 Telecare Generations

In the literature, three generations of telecare are distinguished, see (Stowe and Harding, 2010). The *first generation telecare* denotes the simplest devices, which are composed of a transmitter with a button alarm (worn on the wrist as a bracelet, strapped to the belt, or as a pendant around the neck), a terminal with the function of initiating a call, and the operation centre, to which the signal is sent. Users themselves must activate the alarm by pressing the alarm button in order to obtain help. However, the system becomes ineffective when the telemonitored person is unable to raise the alert (Majeed and Brown, 2006).

The *second generation systems* consist of more advanced devices, automatically notifying of the potential hazard, with no need for the telemonitored person to trigger the alarm. There is a wide range of available sensors detecting smoke, carbon monoxide, temperature, flood or fire, automatically sending information to the operation centre and initiating the necessary response. In the case of a fall or any unusual behavior, other than described as an individual user characteristic (e.g. hours of sleep, taking a medicine), the system automatically calls for help.

Third generation systems include the most advanced devices, offering the possibility of automatic data collection on everyday activities of the telemonitored person. Complex sensors and biosensor systems allow for continuous monitoring of the physiological parameters (body and skin temperature, blood oxygen saturation, heart rate, EEG, EMG, blood glucose, mobility, activity, fall) and individual behaviors (Chan et al., 2012). When the bio parameters deviate from the norm, the alert is sent to the user, his/her relatives and carers. An interesting discussion on smart wearable systems is provided in (Esteve et al., 2012).

In Europe, the telecare systems have been present for decades (Stowe and Harding, 2010). The three main European funding programmes for 2014-2020 that include topics related to the problems of an ageing society are as follows: Active and Assisted Living Research and Development Programme (AAL); Third Health Programme and Horizon2020. Results of the first call dedicated to the *ICT based solutions for Prevention and Management of Chronic Conditions of Elderly People* can be seen e.g. in (Waterworth et al., 2009, Belbahir et al., 2011, Kamel Boulos et al., 2009 and Bourke et al., 2010). Nonetheless, the development of the telecare systems in Poland seems to be significantly slower than generally in Europe. In Poland, the main source of development of telemedicine services is from the private funds of the citizens (Bujok et al., 2015).

2.2 Telecare Systems in Poland

In this section we survey the telecare systems that are available on the Polish market. Our search has been conducted according to the following keywords: 'personal alarm systems', 'telecare systems', 'ageing care' using Scopus, Springer, Elsevier and the Google search engines. Table 1 presents the resulting summary. These systems are described in details in the forthcoming subsections.

At the time of this writing, that is October, 2015, this overview appears to be quasi-complete to the best knowledge of the present authors. Omissions might concern the systems under development, not present on the market, nor publicly announced.

2.2.1 First Generation of Telecare

As shown in Table 1, the most common telecare solutions are personal alarm systems. The devices with alarm buttons are offered by various companies, like *MDT Medical, Makamed, MarTom Security, House Domowa Opieka, RevoApp* and *Polskie Centrum Opieki.* In the majority of these systems there is only one, simple alarm button, initiating a call for help. The *MarTom Security Telecare* system has two additional buttons: green for the case of loneliness and blue if there is a need to call technical assistance. The first generation telecare is also offered by *Polskie Centrum Opieki, MDT Medical* and *RevoApp*, disposing of advanced technologies and more possibilities to protect the telemonitored people (see 2.2.2), but also offering the use of simple devices (without sensor

Table 1: Overview of telecare systems available on the Polish market in October, 2015.

Product/Project	System description	Type	Telecare generation
Makamed Telecare (Makamed Ltd.)	Alarm button	Commercial	1st
Life Button Sara (House Domowa Opieka Ltd.)	Alarm button	Commercial	1st
MarTom Security Telecare (Martom Security Ltd.)	Alarm, loneliness and need of assistance buttons	Commercial	1st
Home Telcare (Polskie Centrum Opieki Ltd.)	Alarm button and sensors (e.g. smoke, gas, fall, leave the room, take drugs)	Commercial	1st and 2nd
Neo GSM (MDT Medical Ltd.)	Alarm button and sensors	Commercial	1st and 2nd
RevoCare (RevoApp Ltd.)	Alarm button, sensors (temperature, humidity, CO, pressure, opening doors, windows, lighting)	Commercial	1st and 2nd
MobiCare (MobiCare Ltd.)	Alarm button, GPS, sensors (fall, lack of exercise, opening the door, smoke, gas, flooding with water)	Commercial	2nd
iSULIN (Military University of Technology)	Non-invasive measurement of blood glucose biosensor, wristband	Commercial	3rd
safeUP (Gadmel)	Wireless sensors for data collection	Commercial	3rd
SiDLY Care (SiDLY Ltd.)	Wristband monitoring vital signs, permanent monitoring health status, sensors	Commercial	3th
DOMESTIC (Gdańsk University of Technology)	Heart rate monitor, sensors for respiratory and physical activity, blood pressure, temperature and network monitoring of domestic events (electricity, water leakage, light)	Research	2nd
RADCARE (Warsaw University of Technology and Bergen University College)	Pulse-radar-based system, low-power radar sensors	Research	3rd
RAAP (Warsaw University of Technology in collaboration with partners)	Robot attendant	Research	3rd

installation) to call for help. For example, *Polskie Centrum Opieki* offers the telecare system combining both first and second generations.

2.2.2 Second Generation of Telecare

As presented in Table 1, three second generation telecare commercial products (*Home Telecare* by the *Polskie Centrum Opieki*, *RevoCare, MobiCare)* are available on the Polish market. There is also one research project (*DOMESTIC*).

Polskie Centrum Opieki is the biggest telecare company in Poland and it has the largest scope with about 1 000 active users. The company collaborates with social welfare centres and provides telecare systems to elderly people. The telecare system is partially or fully funded by local authorities. The

telemonitored person can choose to have only an alarm button, which, in the case of accident, sends a signal to the operational centre (first generation), or additionally, to install various sensors, which detect smoke, gas, fall or activity, e.g. taking a medicine, leaving the room. Signals from the sensors are sent automatically to the operational centre (second generation).

The *RevoCare* system is a wellbeing monitoring device built into a video phone for the elderly, who live alone at home. The telemonitored people can use it on the daily basis to keep in touch with family and friends. This system, besides the alarm button (first generation), has many other features, such as voice and video calls, intercom, notifications, medication reminder, and sensors (second generation) that detect fall, lack of activity, door opening, smoke, gas, and flooding with water (Sokołowski and Stasiełowicz, 2015). The system is in prototype tests now and it is not yet available on the market. It is expected to appear on the market in 2015.

The third company offering a second generation system is *MobiCare*. The system in the basic version consists of the fall detector (attached to a belt or carried as a necklace), motion sensors, door opening detector, remote control keychain (while the user is out of the house), central unit, and the call centre. The system automatically generates alerts when it detects a fall of the telemonitored person, lack of movement in the apartment for a long time or door opening when nobody should be in the house. Additional sensors that are installed within the system can detect smoke, gas, fumes or water on the floor, and trigger an immediate response from the employees of the care centre. In an emergency, care centre contacts the telemonitored person to see how he feels and give him all possible assistance. It can initiate assistance through contact with family, friends, neighbors, and, if necessary, call the appropriate emergency services. There are no data available about the estimated number of users of this product.

The *DOMESTIC* telecare project, dedicated to home assistance for the elders and disabled, results from research carried out at Gdańsk University of Technology. The aim of the project is to develop solutions using modern technologies to promote active and healthy ageing. The outcome should be new organizational solutions, developed prototypes of devices, and software ready for commercial use and implementation by cooperating companies, institutions and organizations. The target group are the elderly, sick, disabled, people with limited mobility. A product ready to sell, *HARN*, is an enhanced remote controller equipped with the ability to measure vital signs and to process text or voice messages/alerts. It measures blood oxygen saturation, electrical activity of the heart, and reminds about events or activities. Products in prototype tests are: *PathMon* – a wearable multisensory device for mobile monitoring of electromechanical coupling of heart and respiration activity (to measure electrical and mechanical activity of the heart, electromechanical coupling in the heart, breath rate, posture and physical activity); *HoAls* (Home Alerts System) is a sensor network monitoring domestic events, such as water, electricity, water leakage, switching lighting and in the case of danger, alarm reporting; *eBathtub* is a system supporting safe bathing in a bathtub; it uses measurements of bio- impedance, ECG, water level, water temperature and others, and is meant to monitor the activity of a bathing person (e.g. sleeping), the risk during bath (e.g. drowning), the water level and water temperature; there is a possibility of automatic water cut off and water dump, if dangerous conditions are detected (e.g. high water level), of automatic triggering and distribution of alerts (e.g. assistance required, heart attack, etc.). There are no data available about estimated numbers of users of this systems, because of the test stage of this research work.

2.2.3 Third Generation of Telecare

Third generation of telecare is still the marginal part of all telecare systems, but the research is dynamically ongoing. Thus, Table 1, accounts for just a fraction of endeavours in this domain, focusing on those that are supposed to appear first on the market. Namely three commercial products (*iSULIN*, *safeUP* and *SiDLY* Care) are announced to appear on the Polish market in 2015. Furthermore, the following two research projects: *RADCARE* and *RAPP* are carried out.

The *iSULIN* product is developed by students of the Military University of Technology in Warsaw. This is a system for monitoring the health hazards of diabetics. The wrist sensor continuously analyses the patient's non-invasive parameters: pulse, blood pressure, blood oxygen saturation and blood sugar levels. Based on these parameters, the system examines the patient and informs about his/her health.

The *safeUP* system offered by *Gadmel* is an autonomous system for the remote care for the elderly. The wireless sensors, installed on everyday usage objects (e.g. doors, first aid kit cabinet, bed) enable collecting signals and sending information to the caretakers. The activity or inactivity of the elderly person is communicated via SMS.

Another project is called Sidly Care and is a multi-sensory device of medical telematics (the wristband monitoring the vital signals). The device is aimed to provide continuous monitoring of the health status and to archive measurements of data in a dedicated mobile application, and then send text message to caretakers. Sidly Care is not yet commercially available.

The *RADCARE* project (Care support for elderly and disabled people by radar sensor technology) is the result of synergy between the leading Norwegian approach to care services for the elderly and Polish technology resources. A pulse-radar-based system can be used to detect and identify some features of the human behaviour (entering or leaving the bed, falling on the floor, revealing an untypical or hyperactive behaviour, stopping too long in a non-typical place e.g. in the bathroom) without the necessity of visual observation of the monitored person, also in a dark room. The system can be used for measuring some parameters of the body functions (pulse, heartbeat, and breathing) in a non-invasive way by using compact, miniature, safe and low-power radar sensors.

The *RAPP project* (Robotic Applications Store for Delivering Smart User Empowering Applications) provides an open-source software platform to support the creation and delivery of Robotic Applications. These applications will enable robots to provide physical assistance to people at risk of exclusion, especially the elderly, to function as a companion. The *RAPP* partnership counts on seven partners in five European countries (Greece, France, United Kingdom, Spain and Poland), including research institutes, universities, industries, and small/medium-sized enterprises. The goal of this project is to identify the best ways to train and adapt robots to serve and assist people with special needs. The *RAPP* project will help to enable and promote the adoption of small home robots and service robots as companions to elderly people.

In general, the telecare systems available on the market in 2015 seem to be at an early stage of development with very limited group of users. The estimated scope, basing on the data obtained from the companies, show that the telecare systems are used just by up to few thousand people in the country, that is, only a minuscule fraction of the whole population.

3 THE DESIRED CHARACTERISTICS

We have performed a limited survey in Social Welfare Centres to investigate the needs for the telecare system from the perspective of the potential users. In this Section, we present first conclusions. The task of the social care is entrusted in Poland almost exclusively with the local self-governmental administration, who often dispose of very limited budgets. Social care services were provided to 88.9k and 69.8k people in 2014 by respectively, non-stationary (provided at home of the elderly and the ill) and stationary Social Welfare Centres in Poland (MPiPS, 2015). Currently, no ICT system is deployed globally to support the caregivers and the caretakers of the Welfare Centers.

The study was carried out basing on a questionnaire and the interviews performed with the representatives of 6 Social Welfare Centres (4 in Warsaw, 1 in Cracow and 1 in Poznan). Questions of the questionnaire concerned persons 65+ and of every sex. The questionnaire was followed with the interviews. The questionnaire focused on the desired functionalities of the ideal telecare system and their attractiveness. The questionnaire asked also for the types of care services, access to these services (in case of 24-hours Social Welfare Homes), an acceptable cost of subscription, needs in the nursing care and evaluations of the psychophysical condition of elders determining abilities or impossibilities of independent using telecommunications devices. For the use in the stationary Social Welfare Centres, the questionnaire has been slightly modified.

The responders were asked to mark a score (1-3) determining the attractiveness of the considered functionality. The outcome of the likes as to the items and functions for the telecare system is presented in Figure 1.

As depicted in Figure 1, the top three desired characteristics for the telecare system, basing on the information from the aforementioned Social Welfare Centres are: alarm button (100%), automatic fall detection (92%) and automatic anomaly detection (83%). From the point of view of the stationary Social Welfare Homes, two functionalities are indicated as most desired: the alarm button (100%) and fall detection (100%). The remaining functionalities are indicated as moderately needed.

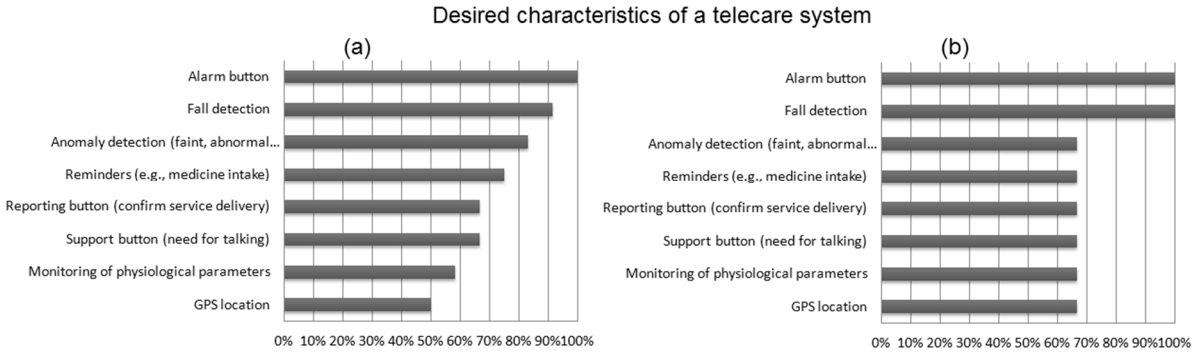

Figure 1: Desired characteristics for the telecare system according to the survey in (a) Social Welfare Centres (b) Stationary Social Welfare Centre.

The proposed functionalities like warning over threats or the measurement of life parameters are attractive for both types of institutions. The interviews showed differences in the expectations concerning the evaluation of work of the personel/staff. From the point of view of the Social Welfare Centres, it would also be very convenient if there is a possibility of confirming the rendering of service for the elderly or disabled person by the respective caretakers. This feature is very important in the context of assessing the provision of service and its quality. The confirmation and quality assessment seem to be important also for the Senior, who would retain the feeling of empowerment and contribution to the functioning of the system.

Within the questionnaire, we have also asked with an open question to indicate the expected monthly price for the telecare system (including measurement devices). According to the collected information, the expected price is 30 PLN (~7.1 EUR) per month for basic features (top 3 desired characteristics) and 45 PLN (~10.7 EUR) per month for the advanced version. Such expectation may become an important constraint when deploying the telecare solution on the Polish market. It needs to be stated that this is also a reflection of the wealth situation of the citizens. Nonetheless, Polish law has no established definition of telemedicine yet and there are no legal regulations allowing for the financing of the telemedicine services by the National Health Fund. The long-term care for the infirm and seriously ill elderly people at home remains mostly with the family.

It also needs to be concluded that during this study the representatives of various Social Welfare Entities expressed high demand for some sort of a telecare system and the willingness to cooperate and implement it. They are stating their awareness of the expected alarming changes in the demographic situation and the readiness to deploy telecare system of the third generation to support the everyday care of elders.

4 CONCLUSIONS

In this paper, first, we have surveyed the state-of-the-are telecare systems that are available on the Polish market or are readying to enter this market. Then, we have described the main related problems and some specific needs for the ICT based telecare systems from the perspective of elders. We have investigated them by performing questionnaire and interviews in Social Welfare Centres.

According to the survey, there are several solutions commercially available that support the care of the elderly (mostly first and second generation telecare systems). The third generations are developed mostly as prototypes within the research projects. The telecare systems on the market seem to be at an early stage of development compared to the international standards with very limited group of users. The estimated scope, basing on the data obtained from the companies, show that the telecare systems are used just by up to few thousand people in the country, that is, only a minuscule fraction of the whole population.

The results of the survey confirm that the telecare system matching the key needs is neither common nor easily available in Poland, not to mention the fact that it is not freely available or financed with public funds. The long-term care for the infirm and seriously ill elderly at home remains mostly with the family. Social Welfare Centres confirm also the limited pricing capabilities. Nonetheless, the investments in the telecare systems are needed to support the functioning of the health and care systems and for the improvement of the

quality of life of older people while retaining their autonomy as human beings

Future research assumes a systematic review of scientific publications focused on the comparative analysis of the ICT based telecare systems in regards to their functionalities, technologies, equipment, price, international orientation and user interface.

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