VIRTUAL MOBILITY (VM) GRANT
REPORT TEMPLATE

This report is submitted by the VM grantee to VNS Manager, who will coordinate the approval on behalf of the Action MC.

Action number: 19136

VM grant title: SHAFE successful business models

VM grant start and end date: 02/05/2022 to 15/09/2022

Grantee name: Luiza Spiru, MD, PhD

Description of work carried out during the VM

New business models in aged care have been developed in order to meet the changes in social expectations of the Baby Boomers generation (people born between 1946 and 1964). Other social changes, such as *phased retirement,* are coupled with aging in place public policy strategies, and technological innovation is blooming in order to meet the demographic change faced by European countries.

Henceforth, we have aim to identify, analyse, and promote the new trends in SHAFE successful and sustainable business models for aging in place, to the stakeholders of the SHAFE ecosystem.

We have analysed and indexed business models developed in Europe, Unites States and Australia and focusing on supporting aging in place.

The care providers look now for innovative approaches in order to make the long- term care sustainable. Hence, preventive care is coupled with digital technologies, while also involving informal caregivers. All these, overall, decrease costs to the extent to which a health and care ecosystem could partly support the digitization, technological and knowledge transfer, and the adoption of innovation at fast rates.

The below table summarizes the new types of services which are now increasingly available on the market.

CLASSIC TYPES OF SERVICES	NEW TECHNOLOGIES TO SUPPORT AGING IN PLACE
CLINICAL SERVICES: ACCESS TO NURSES, PRIMARY-CARE DOCTORS, AND SPECIALISTS,	Digital technology - generating reports and analyses
PERSONAL CARE: HELP WITH BATHING, DRESSING, AND GROOMING **DAILY-LIVING ASSISTANCE: MEAL SERVICES, CLEANING, GARDENING, PAYING BILLS, ETC.**	- data monitoring within the aim of preventing diseases - monitoring for safety (falls, getting lost etc) - technology related products and sensors for monitoring - services for sensor instalment - offering full service (in-home care with medical assistance, cleaning, shopping etc)
SOCIAL CARE: SUPPORT FOR SHOPPING, SOCIALIZING	Platforms and digital technologies

Description of the VM main achievements and planned follow-up activities

We have found that there are some barriers to penetrate the market that are related to some other factors, and not necessarily to the BM model. Some of these factors are the low adoption rate, the perceived privacy threat, lack of consistent added value (carers do not get valuable insights on the elder situation), results and analyses not being delivered to the carer in a user-friendly format and/or a one-glimpse understanding one.

Moreover, most of the services are variations of B2B and B2C and subscription-based services.
We have found that the B2B model would provide a higher penetration rate, taking into consideration that elder assisting technology would lower the cost per patient/center resident by offloading the manual medical parameters measurements, reducing though the necessary human resource.

Even if technology proved its reliability, the B2C model business is not as successful as the B2B model because for many cases the data which is obtained by the end-user is of no relevance or too detailed, or biased towards too medical or too technical content (e.g. data from environmental sensors, medical condition).

In the future, Uber-like market place for domiciliary care services, revenue based on sales commission from care receiver and care givers would be the most successful business model.

Three deliverables have been produced at the end of each task

Executive Summary: Aged care Business Roadmap.
Deliverable 1 – This deliverable describes the new technologies employed in innovative aged care
Deliverable 2 - This deliverable describes successful new business models based on innovative aged care

Aged Care Business Roadmap

The pathway to aging in place safely and in dignity employs a strong emphasis on preventive, accessible and timely support care services. A sustainable aged care system which put at its core the consumer needs is key for developing a care ecosystem based on the adoption of the new technologies, which facilitate and prolong aging in place.

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Currently, most of the services are variations of B2B and B2C and subscription-based services.
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In the future, Uber-like market place for domiciliary care services, revenue based on sales commission from care receiver and care givers promise to be the most successful business model.

- We see that the new business models actively involve the people aged 65 and over along with their families. This promotes a user centred approach in the design of the new products in digital care.
- We have also noticed that there is much investment in improving businesses capacity to meet the care needs and monitoring of normal patterns of behaviour in order to detect any anomalies, on a large range, starting from falls and ending with cognitive decline.
- There is also an increased awareness on what dementia and its care needs are, and innovative pathways to meet the increasing needs from pre-dementia to rehabilitation and independent living to community and governmental support.
- Sustainable aged care sector offers arrangements from early interventions to ongoing basis. Care and support are available on the market from short term early intervention/restorative to smart housing and care houses.
- Collaboration, networking, and partnerships are developed in order to build a sustainable care ecosystem with active participation of education, research and training, with a special emphasis on technological training.

However, this new approach meets criticism and alarm policy makers to improve standards and regulation for long-term care provided at home, including aspects of working conditions and occupational health and safety (Beaten et al, 2018; Lloyd, 2018). In the research report *Towards the Uber-isation of Care. Platform work in the sector of long-term home care and its implications for workers' rights,* Trojansky et al (2020) argue that long term care is not only a service but also a social right and public responsibility and thus, it emphasizes that care platforms are a highly ambivalent phenomenon for care workers' rights (EC, 2020).

Deliverable 1. New technologies for aging in place

Older Adults' monitoring is meant to support reducing caregiver burden & Improving health outcomes for older adults (Czarnuch & Mihailidis, 2011; Madara Marasinghe, 2016; Masterson Creber et al., 2016; Tomita et al., 2010).

These studies merely emphasize that technology, coupled with care-coordination, has the potential to revolutionize the way older adults are "Aging in Place".

Table 1 Selected practices for older adults' monitoring

MET NEEDS	EVIDENCE	NEW TECHNOLOGIES FOR AGED CARE
STROKE RISKS	(Vedantam, 2021)	Biometrics
RISK OF FORGETTING	Signs of Alzheimer's or dementia (Vedantam, 2021)	Digital technologies
RISK OF FALLING	Gait and fall risk (Dolatabadi et al, 2019) (Vedantam, 2021; Rantz et al., 2013; Sun & Sosnoff, 2018).	Gait speed, stride length, and stride time are calculated daily, and automatically assess for increasing fall risk (Rantz et al, 2015; Feldwieser et al, 2014; Savica et al, 2014)
PHYSICAL ACTIVITY (PA)	Functional status and changes (Rantz et al 2015) vital signs identifying a new paradigm of vital signs that are technology enabled (Rao, 2019)	WHO model on International Classification of Function, Disability and Health for mobility disability in the elderly / functional decline (Rantz et al, 2009)
URINARY TRACT INFECTIONS	Importantly, the sensor network detected signs of illness earlier than traditional health care assessment (Rantz et al, 2011)	Bathroom sensors – frequency
COGNITIVE AND FUNCTIONAL DECLINE	The system "learn" normal behaviour patterns, and therefore recognise significant deviations in performance immediately without the need for specific testing.	Gait analysis

2. Directly assessing ADL performance may become more useful as it will highlight exactly where an individual is having difficulty without the reliance on traditional tests, which can be time consuming
3. This will reduce some of the burden on caregivers and allow more time to be dedicated to designing and implementing interventions
4. These interventions will be based on objective performance data rather than subjective measures, healthcare efficiency may be improved. Healthcare professionals should be consulted on this process, as it has been argued that introducing technology does not always improve efficiency due to the required changes in habitual working practice

For the last 10 years, most of the ADL are recognized by using Door + Motion sensors. Most current systems favour motion sensors: a wide range of ADL can be recognised through inference of time spent in a specific room or area of a living space, though inference has its own limitation: **motion sensors alone may not be the most appropriate method of ADL recognition despite their high level of acceptance among older adults. New technologies are now coupled for successfully aged care ecosystems.**

Deliverable 2. Business Models for Aged Care

EXISTING BUSINESS MODEL	TYPES OF SERVICES	BUSINESSES
B2B AND B2C SUBSCRIPTION BASED PRODUCT SELLING (HEALTH CARE DEVICES)	Deliver end-to-end clinical care at home -in-home services: monitoring, collecting samples for medical analysis, telehealth "Hospital at home"	www.currenthealth.com www.clapsens.com
	Home automation system to trigger devices via hand clap Remote assistance, emergency call, home automation, automatic lighting	https://www.legrand.fr/
UBER-LIKE MARKET PLACE FOR DOMICILIARY CARE SERVICES. **REVENUE BASED ON SALES COMMISSION FROM CARE RECEIVER AND CARE GIVERS**	A contact/scheduling board where all carers and clinicians can share information; A sensing platform that collects data from the house and the supported person's activity An on-demand service through which home care services and training can be commissioned.	**ESTIA UK**
SUBSCRIPTION BASED	Care management software predict falling and cardiac arrest Wristband for senior tracking and SOS calls	**VITALERTER** www.acticheck.com www.e-vone.com
RESEARCH GRANTS	The platform compiles an enormous amount of data, known as Big Data. real-world and real-time activity and health data transforming clinical research into behavioral health and independent aging.	**ORCATECH**
FRANCHISE-LIKE SYSTEM: *FULL AGING IN PLACE POLICY AND PROCEDURE MANUAL, STAFFING MODEL, EXAMPLE CONTRACTS, AND LEGISLATIVE WORDING/CHANGES $5,000.* **CARE CENTER**	• The AIP model combines home care services with registered nurse (RN) care coordination The RN care coordinator manages the client's care across all disciplines (nursing, medical, physical therapy, social work, hospice, and others)	**TigerPlace**

	uses technology to promote early illness recognition and fall detection • Platform for remote assistance and call buttons	https://bluelinea.com/
MONITORING PRODUCTS SALE - SUBSCRIPTION	4G and GPS connected insoles	https://gpssmartsole.com/gpssmartsole/
MONITORING PRODUCTS SALE - SUBSCRIPTION	Luminaire for tracking the person (3D camera and sensors)	https://nobi.life/fr/
B2B; MONITORING PRODUCTS SALE - SUBSCRIPTION	Remote assistance solutions, B2B hardware producer	http://www.attentive-technologies.fr
B2B PRODUCT SELLING	Remote assistance, emergency call, home automation, automatic lighting	https://www.legrand.fr/
B2C PRODUCT SELLING	Bedside table with usb socket, auto lighting, etc.	www.aina-lab.com
B2B AND B2C	Ground connected for fall detection and movement analysis	www.future-shape.com
CAMERA SURVEILLANCE SYSTEM, WITH EDGE COMPUTING FOR DETECTION OF EXITS AND FALLS	Camera surveillance system, with edge computing for detection of exits and falls	
B2B PRODUCT SELLING	Airbag belt for fall protection	www.sp-tech-active.ch

Business models with registered nurse or a formal care provider who 'reads' data

The below business models show that the remote sensor technologies or environmental sensors are serving as prompts to domiciliary care services, which support people to age in place. The monitoring systems support scaling up the businesses in domiciliary care services/ support health and care providers.

Table 2 Businesses based on remote sensor technologies supporting care services

UK	Current health	Healthcare organizations to personalize and scale how they deliver healthcare at home with a single, flexible solution.	Https://www.currenthealth.com/
	ESTIA- The Elderly Support to Inspired Ageing digital platform (Bourikas et al, 2017)	(1) A contact/scheduling board where all carers and clinicians can share information; (2) A sensing platform that collects data from the house and the supported person's activity; and (3) An on-demand service through which home care services and training can be commissioned.	The ESTIA platform will provide a dynamic, shared-economy (Uber-like) market place for domiciliary care services. In essence, this project aims to provide more efficient care services with less administration cost. Finally, platforms such as ESTIA optimised for individual care, may demonstrate a structured transition from state supported to community supported care.
ISRAEL	VITALERTER	predict falling and cardiac arrest	
USA	ORCATECH The Oregon Center for Aging and Technology, housed inside the Oregon Health and Science University in Portland	behavioral patterns: translating that data into actionable health and wellness outcomes, improving the aging experience.	https://www.ohsu.edu/oregon-center-for-aging-and-technology Initiatives: 1) ORCASTRAIT facilitates the wise use of technology to improve care provider support 2) CART (Collaborative Aging Research using Technology) is an initiative supported by the National Institutes of Health and the Department of Veterans Affairs to enable our national research enterprise to use digital technologies to improve aging research
	TigerPlace	University of Missouri (MU) are using sensor technology	The AIP model combines home care services with registered nurse (RN) care coordination. Care coordination is a key component of AIP. The RN care coordinator manages the client's care across all disciplines (nursing, medical, physical therapy, social work, hospice, and others) making sure the client receives the care needed to age in place. The clinical outcomes are also better for clients receiving community-based care with RN care coordination THAN without or care mix at nursing homes plus potential savings.

Business Models with Sound Monitoring and ADLs recognized

Table 3 Business based on Sound monitoring and ADLs recognized

Reference	Year	System / Sensor Name	Recognised ADL	Type of Sensor/s included	Outcome Measure
Commercial ADL recognition systems <u>not</u> used in research				
[44]	/	MiMonitor	Feeding, Grooming, Mobility, Social interaction	Door contact	Door usage
				Motion	Room movement
				Video Camera	
[45]	2004	Just Checking	Grooming, Mobility, Social interaction	Door contact	Door usage
				Motion	Room movement
[46]	2013	Canary Care	Grooming, Mobility, Social interaction	Door contact	Door usage
				Motion	Room movement
				Light	Room usage
				Temperature	
[47]	2015	Memo-Hub	Feeding, Grooming, Mobility, Social interaction, TV watching	Door	Door usage
				Motion	Room movement
				Power consumption	Electrical appliance use
[48]	2017	Tec-Angel	Grooming, Mobility, Social interaction	Door contact	Door usage
				Motion	Room movement
[49]	2018	Text Care	Feeding, Grooming, Mobility, Social interaction	Door contact	Door usage
				Light	Room usage
				Sound	
				Temperature	
				Motion	Room movement
[50]	2019	Howz		Door contact	Door usage

<div align="right">Source: Camp et al, 2021</div>

State of the art of the monitoring systems based on sound, noise, and alerts

Chin et al (2021) innovative combination of acoustic sensing, artificial intelligence (AI), and the Internet-of-Things (IoT), which we argue in the paper that it provides a cost-effective approach to alerting care providers when an elderly person in their charge needs help. Most of the innovation in our work concerns the AI in which we employ Machine Learning to classify the sound profiles, analyse the data for abnormal events, and to make decisions for raising alerts with carers. A Neural Network classifier was used to train and identify the sound profiles associated with normal daily routines within a given person's home, signalling departures from the daily routines that were then used as templates to measure deviations from normality, which were used to make weighted decisions regarding calling for assistance.

We noticed that home mobility monitoring systems in visiting nursing practice is a supportive tool for monitoring daily activities in community-dwelling older adults (Son and Kim, 2019).

Generally, monitoring systems based on sound or motion are designed to trigger emergency alarms. Functional and cognitive decline through motion density maps is recorded by the TigerPlace with a registered nurse.
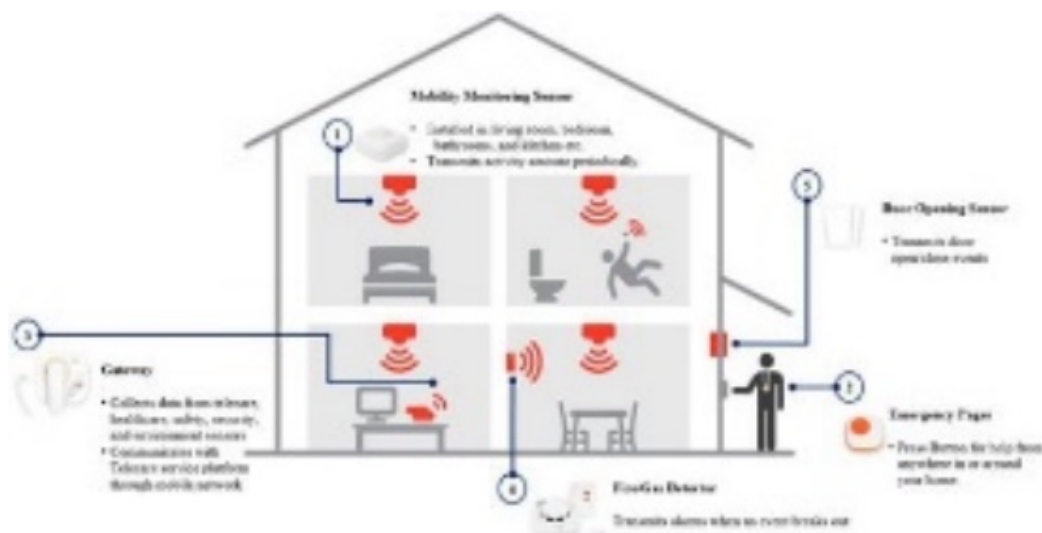
Source: Son and Kim, 2019

Strauss et al (2008) advanced a remote monitoring system, which relies on a real time multichannel implementation based on an USB acquisition card. The sound environment is monitored while everyday life sounds and outliers (distress expressions) are identified in order to participate to an alarm decision.

Haoyuan et al (2021) presents a sound monitoring sensor to judge the activity state of the elderly through the sound. If there is abnormal signal in the voice of the elderly, the family members can be informed to realize abnormal detection in the first time.

Noise monitoring using distributed Raspberry Pi computers in a domestic setting. The goal of this study is to evaluate the potential for using off-the-shelf, low-cost components to develop a wireless sensor network for unobtrusive sound monitoring in a domestic environment, where anomalous readings trigger alerts. The study investigates the transferability of the prototype into assisted living to enable seniors to live independently in their own homes (Griffiths et al, 2016)

An embedded PC, equipped with a classical sound card and a microphone, is capable of real-time detection and analysis of sounds to detect distress situations. The system requires further refinement to improve its accuracy before it can be evaluated in real-life. s: The system was found to be reliable for detecting and classifying sounds at signal to noise ratios of 10 decibels (dB) or more, with an error rate of 5% or less. However, it was less efficient at sound and speech recognition (Istrate et al, 2008).

Goonawardene et al (2017) show how a non-intrusive sensor-based monitoring system comprising of motion-sensors and a door contact sensor can be utilized to detect elderly who are at risk of social isolation. They have found that the overall social isolation level of the elderly and the time spent in

the living room is positively associated with the emotional loneliness level. Further, elderly who perceived themselves as socially lonely tend to take more naps during the day time.

Nazerfard and Cook (2015) Recent advances in the areas of pervasive computing, data mining, and machine learning offer unique opportunities to provide health monitoring and assistance for individuals facing difficulties to live independently in their homes. Several components have to work together to provide health monitoring for smart home residents including, but not limited to, activity recognition, activity discovery, activity prediction, and prompting system.
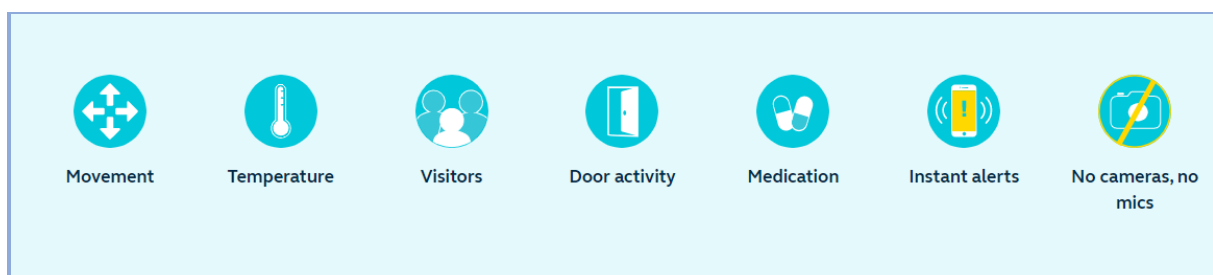
a. Sound and motion visual display at TigerPlace

Marilyn Rantz, TigerPlace founder, wrote a series of articles on the innovation taken in the Aging in Place Community. Motion density maps is of paramount interest to our research

Rantz et al (2013) Motion density maps are used to visually track activity levels. Activity patterns can be visualized or automatically tracked for pattern changes over time.

Color is used to represent density (activity level) ranging from gray (50 events per hour) to blue (550 events per hour). Black indicates time out of the apartment. White denotes no activity.

Additional maps, like "Time in Bed" or "Bathroom visits" were created as well.

Motion density maps are used to visually track activity levels

| Movement | Temperature | Visitors | Door activity | Medication | Instant alerts | No cameras, no mics |

Canary Care

https://www.canarycare.co.uk/

No wires. no Wi-Fi, just peace of mind

The discreet, wireless sensors monitor movement, temperature and door activity, which you can view from anywhere via a very clever portal. You don't need an internet connection or a phone line and you can enable text and email alerts.

Monitoring activity

Monitor as much or as little as you like, for example:

Movement   Bathroom visits   Visitors   Sleep

See if Mum's been in the kitchen yet this morning, and set a rule to let you know if she hasn't. It could be that she's not feeling too good – a quick call will let you know whether she needs help or not.

a) TEC Angel

tec-angel.co.uk
01245 860 252
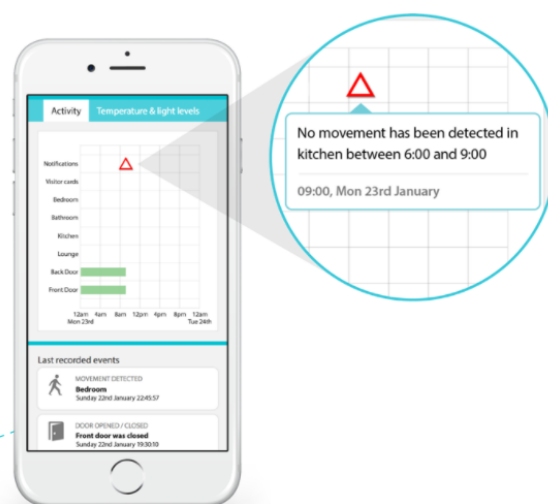
Sadly, we have to inform you that Arc Informatics Ltd, the manufacturer of TEC-Angel, have decided to close the business permanently (effective 31/8/2020).

While a perfectly sound product, TEC-Angel never made enough sales to make it viable long term.

If you have any warranty issues, please e-mail orders@tec-angel.co.uk (this sole inbox will remain active & checked).

If you wish to contact any ex-members of staff please also e-mail orders@tec-angel.co.uk and those requested will be forwarded to their private e-mails.

Finally, any approaches regarding purchasing our product line or technology are welcome also at orders@tec-angel.co.uk.

Yours faithfully,

Nigel Mills BSc CEng FIET
Founder & Director.

Overview

TEC-Angel is a monitoring and alert system to help any vulnerable person living alone stay safe in their own homes, keeping their independence, dignity and privacy while giving those who care for them peace of mind.

The discreet system warns a carer by text if something happens that affects their normal routine without requiring any lifestyle changes or the wearing of a call button or tracker, even if they are unconscious or incapacitated.

TEC-Angel is a standalone system with no internet, landlines or monthly subscriptions to TEC-Angel required. Allowing families to manage their loved ones care, TEC-Angel offers discreet, reliable support 24/7 and is ideal for both long and short term users.
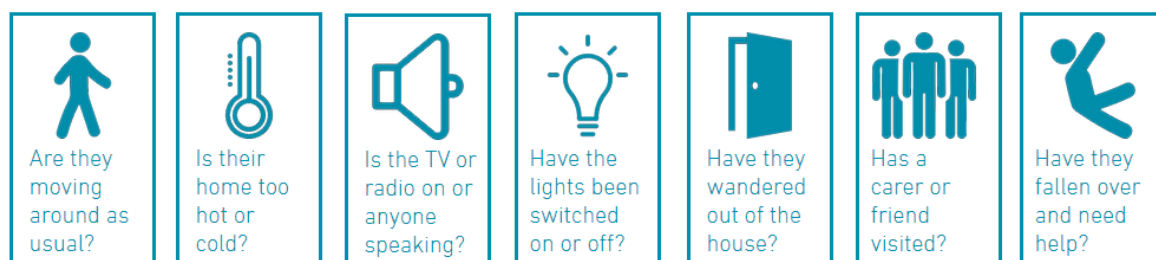
Founded: 2012

Specialties

> monitoring and alert system, technology enabled care, vulnerable people, telecare, engineering, and independent living

b) Text Care

Are they moving around as usual?	Is their home too hot or cold?	Is the TV or radio on or anyone speaking?	Have the lights been switched on or off?	Have they wandered out of the house?	Has a carer or friend visited?	Have they fallen over and need help?

Text message alarms

If something out of the ordinary occurs such as an accidental fall, a drop in room temperature or if the panic alarm has been pressed, TextCare immediately sends you a text message alarm so that you can take action to help your loved one. Alarms can be pre-defined by you and set-up at any time via text message or by using your TextCare online portal.

Updates on demand

For an instant update on your loved one, such as to see if they are out of bed and moving around, simply send a report request via text message to your TextCare monitoring system. You will then receive activity levels for each area that is being monitored, straight to your mobile phone. This information can be used to determine whether normal routines are being followed. You can also receive this information in a scheduled daily report, which can be sent to up to eight phones.

https://www.amazon.co.uk/Alcuris-Memo-Hub/dp/B08ZYJFML5

To have installed the Memo Hub device and monitoring sensors in your family member's home.

https://justchecking.co.uk/

Activity monitoring **Door monitoring** **Accurate assessments** **No Cameras or microphones**

Activity monitoring system which helps care professionals complete objective, evidence based care needs assessments of adults with dementia, learning disabilities and autism

Partial conclusion:

Further investigation of the performance of the businesses presented at pages 5-8 is needed, as well as a subtle understanding of what make businesses in UK based on remote monitoring systems to flourish?

How frequent are similar businesses in the German speaking countries (i.e. Germany, Austria and Switzerland)? How frequent are they in the Mediterranean countries?