Along with most other developed countries, the UK is experiencing population ageing, due to a sustained decline of birth rates below replacement fertility. By 2051, people over 65 are likely to represent over a quarter of the UK population, their number will have risen by 81% in five decades to reach 16.8 million by 2051. The number of people aged 85 and over is projected to grow at a faster rate, from 1.1 million in 2000 to 4 million in 2051, which represents a drastic increase of 255%.

The demographic shift is an irreversible and unprecedented phenomenon, which is set to have serious socio-economic implications for the UK, its economic growth, its labour market, and its social welfare model, particularly with regards to its pensions systems and its public sector health-care budgets. It will also affect family composition and living arrangements, and there is a risk that a larger population of older people will become marginalised and socially excluded.

Recognising that the rapid ageing of the population is challenging the economy and the social welfare systems in place, the UK government has developed policies that aim to address these issues, especially with regards to health- and social-care services which are affected by rapidly rising costs and a shortage of health- and social-care professionals. These policies stress the importance of improved support for carers and the development of integrated and person-centered services that fit the needs of older people and patients with chronic diseases. As there is growing recognition across government departments of the potential of technology to address the challenges set by an ageing population, UK policies are supported by a range of initiatives promoting the deployment of innovative telecare and assistive technologies and new managed services to enhance and maintain the health, independence and well-being of older people at home.

Population ageing will not only stimulate the market for assistive and telecare technologies, but will offer opportunities to electronic device manufacturers in a range of areas from intelligent home and office spaces to smart transport solutions. The convergence of pervasive computing, ubiquitous telecommunication and intelligent devices offers new possibilities to create smart environments that are able to recognise and respond to the needs of individuals in a seamless and unobtrusive way, whilst remaining under the control of people. In the coming decades, ambient intelligence may be able to assist people with physical limitations or dementia disability in living longer in their own home, where they feel comfortable, without requesting assistance from carers. However, widespread deployment of ambient intelligence will only be possible when solutions are found to current existing problems related to cost, interoperability, accuracy and reliability of technology.

Muriel Jayawardene

Pera Knowledge
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1.0 Introduction – major drivers of change

Along with most other developed countries, the UK is experiencing population ageing, due to a sustained decline of birth rates below replacement fertility. By 2051, people over 65 are likely to represent over a quarter of the UK population, their number will have risen by 81% in five decades to reach 16.8 million by 2051. The number of people aged 85 and over is projected to grow at a faster rate, from 1.1 million in 2000 to 4 million in 2051, which represents a drastic increase of 255%.

The demographic shift is an irreversible and unprecedented phenomenon, which is set to have serious socio-economic implications for the UK, its economic growth, its labour market, and its social welfare model, particularly with regards to its pensions systems and its public sector healthcare budgets. It will also affect family composition and living arrangements, and there is a risk that a larger population of older people will become marginalised and socially excluded.

Recognising that the rapid ageing of the population is challenging the economy and the social welfare systems in place, the UK government has developed policies that aim to address these issues, especially with regards to health- and social-care services which are affected by rapidly rising costs and a shortage of health- and social-care professionals. These policies stress the importance of improved support for carers and the development of integrated and person-centred services that fit the needs of older people and patients with chronic diseases. As there is growing recognition across government departments of the potential of technology to address the challenges set by an ageing population, UK policies are supported by a range of initiatives promoting innovative telecare and assistive technologies and new managed services to enhance and maintain the health, independence and well-being of older people at home.

Population ageing will not only stimulate the market for assistive and telecare technologies, but will offer opportunities to electronic device manufacturers in a range of areas from intelligent home and office spaces to smart transport solutions. The convergence of pervasive computing, ubiquitous telecommunication and intelligent devices offers new possibilities to create smart environments that are able to recognise and respond to the needs of individuals in a seamless and unobtrusive way, whilst remaining under the control of people. In the coming decades, ambient intelligence may be able to assist people with physical limitations or dementia disability in living longer in their own home, where they feel comfortable, without requesting assistance from carers. However, widespread deployment of ambient intelligence will only be possible when solutions are found to current existing problems related to cost, interoperability, accuracy and reliability of technology.

2.0 An ageing society

The world population is ageing due to higher life expectancy and a decline in birth rate below replacement level. The trend is irreversible and represents an unprecedented process in the history of humanity.

2.1 The demographic shift

The number of people aged 60 years and over worldwide has tripled from 1950 to 2000. According to recent estimates from the United Nations, in 2006, over 700 million older persons (those aged 60 years or over) were estimated to be alive and it is expected that, by 2050, their number will leap to 2 billion, which would imply that the population of older persons will have tripled again in the span of 50 years.

At present, the number of older people worldwide is rising at a rate of 2.6% per year, whilst the population as a whole is growing at a considerably slower rate of 1.1%. This demographic shift is expected to intensify over the years. Having risen steadily from 8% in 1950 to 11% in 2007, the percentage of older people is predicted to reach 22% in 2050, by which time older people will have outnumber children worldwide.

In addition, the population of older persons itself is ageing, with people in their 80's representing the age group that experiences the fastest growth rate among those aged 60 years and over.

2.2 A worldwide phenomenon

Nearly all countries of the world are affected by an ageing population. However, the industrialised world is facing the most immediate impact of the ageing transition, with Japan, Europe and Northern America experiencing the most disruptions. In the developed world, over a fifth of the population is currently aged 60 years or over, and the
number of people in this age group is expected to account for a third of the population by 2050. In contrast, the proportion of older people in developing countries is around 8%, but is projected to rise to a fifth of the population by 2050.

![Percentage of total population chart](chart)

Figure 1: Percentage of older people in the world, by major geographical areas

Today, developing countries account for approximately 62% of the 700 million people aged 60 and older, and by 2020, this proportion is expected to rise to 70%. These countries currently face a higher rate of ageing population than developed nations. By 2050, it is expected that the number of persons aged 60 years and over in the developing countries will be nine times as great as it is today.

2.3 How population is ageing globally

**European Union** The EU’s elderly population is forecast to rise by 52% (40 million) by 2030, while the number of people aged 15 to 64 will decline by 6.8% (21 million). The EU working-age population is likely to fall by around 40 million from 2000 to 2050, and the elderly dependency ratio is forecast to double from 23% to 53%.

**United States** In the US, the number of workers aged 55-64 will have increased by more than half in this decade, at the same time as the proportion of 35 to 44 year old people declines by 10%. In addition, the US population aged 65 years and over is expected to double in size within the next 25 years. By 2030, around 72 million Americans will be 65 years or older, which represents almost one in five people.

**Japan** With half of its population aged over 43 years, Japan is the country with the oldest population in the world. In addition, its working age population is predicted to decline by over 37% by 2050. At which time, the elderly dependency ratio will have reached 1:1.

**China** China has around 130 million elderly residents, who account for 11.4% of its population. While this percentage is low in comparison to Japan, Europe, Australia and North America, due to its large population, China is already home to more older people than any other country of the world. Due to the strict one-child family policy introduced in order to control China’s booming population, the country faces a dramatic change in the proportion of old and young people, a rising number of single young people in China are facing the prospect of caring for both their parents and grandparents, a phenomenon known as a 4-2-1 family.

The number of pensioners in China is growing by 3 million a year, and the ratio of social security payers to pensioners has decreased from 10:1 in the 1990s to the current 3:1. By 2050, its elderly population is predicted to rise by 31% and to exceed 430 million people, which is far greater than the combined elderly populations of North America, Europe and Japan.

3.0 Population ageing in the UK

Along with most other developed countries, the UK is experiencing population ageing, due to a sustained decline of birth rates below replacement fertility.

3.1 The demographic shift

The figures below illustrate the demographic change affecting the shape of the UK society. This shift will continue to take place over the next 30 to 50 years. Between 1971 and 2003 the number of people over 65 rose by 28%, whilst the proportion under 16 fell by 18%. The proportion of over-65s and especially over-80s is forecast to sharply grow, due to the large numbers of
people born after World War II and during the 1960s baby boom that are now reaching retirement age.

In 2017, the UK is set to have around 2.4 million more people aged 65 and over than in to 2004. It is also forecast that, between 1995 and 2025, the number of people over 80 will have almost risen by a half, whilst the number of people aged over 90 will have doubled.

By 2051, over-65s are likely to represent over 25% of the population. Their number is set to rise by 81% in five decades to 16.8 million by 2051. The number of people aged 85 and over is projected to grow faster, from 1.1 to 4 million over 2000–2051, an increase of 255%.

### 3.2 The elderly population – key characteristics

The UK elderly population is not a homogeneous group, and will become less so as life expectancy increases.

#### Sex disparity

On average, women have a longer life expectancy than men, which means that they make up the majority of the elderly population. Currently, women account for 55% of persons aged 60 years and over, and 64% of those aged 80 years or over, being nearly twice as numerous as men in the latter age group. Due to their longevity and their lower propensities to remarry, older women are more likely than older men to live alone.

#### Ethnic diversity

The black-and-ethnic-minority population in the UK has a younger age profile than the rest of the population, accounting for 4% of all elderly people in Great Britain. However, the number of older people in the UK from black and ethnic minority groups is on the rise, a rise projected to continue, although there is uncertainty on the scale of the change.

#### Growing disposable income

Over the past twenty years, pensioners’ incomes have risen steadily, increasing about twice as fast as average earnings. Between 1979 and 2002–03, they have almost doubled in real terms - that is after taking account of inflation. As a result of this growth, pensioners are no longer any more likely to be on a low income than the rest of the population. In addition, the standard of living experienced by older people tends to be higher than income alone suggests, since they can also draw on savings and benefit from concessions and favourable tax treatment.

#### Increasingly technology-literate

The current elderly population forms a very heterogeneous group in their usage of information and communications technologies (ICTs), their skills and attitudes as well as in their lifestyles. However, the new paradigm of active ageing means that as UK citizens live longer, and remain in better health than in the past, their habits and lifestyles will change accordingly. Those soon to become ‘older people’ by 2020 are now baby-boomers in their 50s, a population, which uses a whole range of ICT applications. In 2002, over half of the UK population aged 50 and over had a mobile phone, and more than one third were Internet users and had access to a computer at home, according to research from the European Commission.

#### Healthy life expectancy rising

Older people have healthier lives than before. Healthy life expectancy – the
number of years spent in good health – has risen steadily over the past two decades, while remaining roughly constant as a proportion of people’s overall life expectancy. For most people, long-term illness and physical dependency concentrate in a relatively short period in the last years of life. Even at age 80 and over, it appears that a large majority of the population living at home is able to manage independently.

**Older people are not a homogeneous group, and will become less so as life expectancy increases. Supporting independence and control in later life therefore means different things at different stages.** For a large proportion of the population above State Pension Age, independence depends on a decent income, comfortable housing, being able to get around in the community and having good social networks. For a minority (although increasingly for older ages), being independent may require more support.

### Rising expectations

Baby boomers in the UK benefit from higher standards of living than any preceding generation. They have not experienced economic depression or war years, and have grown up in a consumer society, profiting from better health, material comfort, and education. As a result, they are used to diversity and choice; are more conscious of their rights as consumers and expect good customer services. It is likely that even when reaching older age, the baby-boomers will remain more demanding than previous generations.

### 4.0 Impacts of population ageing

Population ageing is a pervasive and unprecedented phenomenon, which is set to have serious socio-economic implications for our societies. The global demographic shift will have a significant impact on our economic growth, our labour market, and our social-welfare model, particularly with regards to our pensions systems and our public-sector health-care budgets. It will also affect family composition and living arrangements, and there is a risk that a larger population of older people will become marginalised and socially excluded.

#### 4.1 The UK labour market

As the population ages, so does the UK workforce. This trend is likely to accentuate in the future, since the government has set a Public Service Agreement (PSA) target to increase the employment rates of people aged between 50 and 69. A number of legislative reforms have already been introduced aimed at extending individual's working life and giving more generous state-pension deferral options.

In recent years the employment rates of both older men and women have increased and moved towards the average employment rates for those aged between 16 and State Pension Age. The employment rate of men aged between 50 and State Pension Age is now higher than at any time since the early mid-1980s.

State pension age for women will increase from 60 to that of men, 65, over the period from 2010 to 2020. The government will also gradually increase state-pension age to 68 for both men and women between 2024 and 2046, to reflect increasing longevity in society, make the state pension affordable in the long term and meet some of the cost of restoring the link between pensions and earnings. In addition, the earliest age from which a non-state pension can be taken will increase from 50 to 55 by 2010.

Age equality is supported by current employment law, and the Age Positive campaign aims to help change employers’ attitudes towards older workers. There is also a range of measures in place to support older people returning to work, including initiatives such as the Pathways to Work, New Deal 50 plus and the New Deal for Skills.

As the number of older people in employment increases, there may be opportunities for UK businesses to develop technology and services that can assist older people in their daily work routine.

#### 4.2 The UK health- and social-care system

A demographic change of this magnitude together with rising public expectations creating constant pressure for increased health services and constraints on national financial resources allocated to health care represent a significant challenge to the UK health-care system.

##### 4.2.1 Caring for older people – current costs

In general, older people use more health-care services than younger ones. In 2003–04, the NHS spent 43% of its
budget — £16 billion — on people aged over 65. In 2002, people aged over 65 made up 16% of the total UK population, but accounted for over a third of spending on hospital and community health services, according to HM Customs; they occupied almost two thirds of general and acute hospital beds; and accounted for 50% of the recent growth in emergency admissions.

Older people tend to have a much greater need for health and social services than the young, so the bulk of health and social care resources are directed at their needs. Older people suffer from a wide range of chronic sickness. The most common are heart and circulatory diseases and musculoskeletal ailments. This gives rise to a rate of disability or dependence that rises with age. See Figure 4.

Older people are likelier than others to be disabled. Around 50% of disabled people in England are 65 or older. The commonest disabilities relate to movement, vision and hearing. In 2006, there were over 15 million people in England with longer-term health needs. As the population continues to age, this is projected to rise by over a million per decade, and long-term chronic conditions in older people are expected to raise the cost of health care up.

4.2.2 Health- and social-care expenditures

Expenditure on the National Health Service (NHS) rose from £62.5 billion in 2001 to reach approximately £89.8 billion in 2005, which represents a compound annual growth rate of 9.51% for 2001–2005.

Securing Our Future Health: Taking a Long-Term View, an independent review published in 2002, states that it us expected that total NHS expenditures will rise to around £154–184 billion by 2022–23 (in 2002–03 prices), which represents a considerable increase from current levels of spending. The review stressed that the UK must expect to devote a significantly larger share of its national income to health care over the next 20 years. It projected NHS spending to grow at a compound annual growth rate of between 4.2% and 5.1%, in real terms, during the twenty years period. The review also predicted that total UK health spending will rise from 7.7% of national income in 2002–03 to between 10.6% and 12.5% by 2022–23.

The forecasts are based on a number of assumptions made about changing patient and public expectations, advances in medical technologies, changing health needs of the population, including demography, prices for health-service resources, and a level of productivity improvement. However, it is worthwhile noting that there is considerable uncertainty over what will happen to levels of illness among older people, so the report may underestimate the cost of caring for frail older people.
budget. The independent 2002 review predicted that core spending on personal social services for adults in England could rise to approximately £10 to £11 billion in 2022–23 (in 2002–03 prices), as a direct result of the impact of demography and health status changes. The projection suggests that the ageing of the population may create greater cost pressure for social care than health care.

4.2.3 Costs of long-term care for older people

In 2004, researchers from the London School of Economics established that if patterns of care stay the same, in order to keep pace with the demographic shift affecting the UK population, occupied places in residential care homes, nursing homes and hospitals would need to rise from approximately 450,000 in 2000 to around 1,130,000 in 2051 – an increase of 150%.

Other findings from the research, presented below, illustrate the profound impact that population ageing may have on future costs of long-term care for older people, if the UK government fails to put in place appropriate policies to address the change.

The number of home care hours would also need to increase, from around 2.0 million a week in 2000 to over 4.8 million a week in 2051 – an increase of around 137%.

Long-term-care spending in the UK would need to rise by around 315% in real terms between 2000 and 2051 to meet demographic pressures and allow for real rises in care costs, if dependency rates, patterns of care and funding arrangements remain unchanged.

On this basis, spending on long-term care would need to increase from about 1.4 per cent of GDP in 2000 to around 1.8 per cent of GDP in 2051, assuming a real increase of 2.25 per cent a year in GDP.

Public expenditure on long-term care is projected to reach around 1.2 per cent of GDP in 2051 under current funding arrangements and around 1.5 per cent of GDP in 2051 under a policy of free personal care with an assumed 25 per cent increase in demand for domiciliary services.

The share of total long-term-care costs met publicly is projected to be almost 80 per cent in 2051 under a policy of free personal care, and around 66 per cent if funding arrangements do not change.10

5.0 UK strategy for an ageing society

The government has recognised that the rapid ageing of the UK population is challenging the economy and the social-welfare systems in place. As a result, it has developed policies that aim to address these issues, especially with regards to health- and social-care services which are affected by rapidly rising costs and a shortage of health- and social-care professionals.

These policies stress the importance of developing integrated and person-centered services, and are supported by initiatives promoting the deployment of innovative telecare and assistive technologies and new managed services to enhance and maintain the health, independence and well-being of older people at home.

5.1 Opportunity age

Published in March 2005 by the Department for Work and Pensions, Opportunity Age: Meeting the Challenges of Ageing in the 21st Century presents a strategy for helping older people retain their independence and control over their lives, and ensuring that they can work and play an active role in our society.

The strategy focuses on three key areas:
- work and income to achieve higher employment rates overall and greater flexibility for over 50s in continuing careers, managing any health conditions and combining work with family (and other) commitments
- active ageing to enable the elderly population to play a full and active role in society
- services that allow people to keep their independence and control over their lives as we grow older, even if they are constrained by the health problems which can occur in old age.11

The strategy is backed up by programmes that improve services offered to adults in order to help them live at home independently. Programmes include, for example, the Disabled Facilities Grant and the Supporting People initiative, which provides a range of housing-related
support services to enable vulnerable people to live independently in the community.

5.2 Policies supporting care for older people at home

In recent years, a number of health-care and social-services strategies and policies have emerged that support the promotion of independence, recognise the impact of this on improving capacity in the care system, and discuss choice and diversity of provision, improved support for carers, and the development of integrated and person-centred services that fit the needs of older people and patients with chronic diseases. These policies are of direct relevance to the implementation of telecare and assistive technology.

5.2.1 The NHS plan

The national priorities for the NHS and social care are based on the Department of Health’s Public Service Agreement (PSA) targets, which cover four broad priority areas: health and well-being of the population, long-term conditions, access to services, and patient and user experience. Key targets include reducing waiting times for out-patient appointments and reducing in-patient treatment and waits in accident and emergency (A&E) departments.

There are also two national targets that support personalised care for people at home by moving from reactive care towards a systematic, patient-centred approach:

- national target to improve care for older people: to increase by 2008 the number of those supported intensively to live at home to at least 34% of all people being supported at home or in residential care
- the national target to improve care for people with long-term conditions: to offer a personalised care plan for vulnerable people most at risk, and to reduce emergency bed days by 5% by 2008 through improved care in primary and community settings.

5.2.2 The national service framework for older people

In 2001, the Department of Health published the National Service Framework for Older People. The publication sets standards for the care of older people across health and social services. One of the key objectives of the Framework is to enhance intermediate care services at home or in care settings in order to promote the independence of older people, prevent unnecessary hospital admission, enable early discharge from hospital, and stop premature or unnecessary admission to long-term residential care.

The national service framework for older people also includes a commitment to "[d]eveloping an approach to telecare investment to support the promotion of independence of older people through assistive technologies". The NHS plan outlines a major package of investment to improve services and standards of care for older people, committing an extra £1.4 billion for older people to be provided annually by 2004. The ten-year programme of improvement is to be implemented through local health- and social-care partners and national underpinning programmes.

5.2.3 Our health, our care, our say

In January 2006, the Department of Health published the White Paper Our Health, our Care, our Say: A New Direction for Community Services, which confirms the vision set out in the 2005 Green Paper Independence, Well-being and Choice. The strategy calls for a shift in services delivery in the whole health- and social-care system towards providing better prevention services, earlier intervention, more personalised services, and more support for people with long-term needs. The white paper promotes a more integrated approach to care and highlights the contribution telecare and other assistive technologies can make in helping people retain their independence and improve their quality of life.

In November 2006, an update on the implementation of the white paper was published, which gives examples of progress at local level and gives a timetable of future developments including some large-scale integrated care and assistive technology pilots, such as the whole-system long-term-conditions demonstrator programme.

5.2.4 A national dementia strategy

The government is also planning to introduce a national dementia strategy, as demographic changes mean that the disease will impact on an increasing number of families in the future. In August 2007, a 12-month programme was announced, which will be looking at the following three areas:

- improving public awareness and professional understanding of dementia
developing services for early diagnosis and intervention
improving the quality of care for patients with dementia.

5.3 Initiatives driving the market for telecare & assistive technology

There is growing recognition across government departments of the potential of technology including telecare and assistive technology to address the challenges set by an ageing population. The Department of Health, especially, stresses that telecare has huge potential to reduce unnecessary hospital admissions and improve people’s quality of life.

**Telecare offers choice and flexibility of service provision, from familiar community alarm services that provide an emergency response and sensors that monitor and support daily living, through to more sophisticated solutions capable of monitoring vital signs and enabling individuals with long-term health conditions to remain at home. [...]**

The expected introduction of a national tariff under Payment by Results (from April 2006) to cover pricing for A & E visits, emergency admissions and ambulance call-outs, as well as elective surgery, provides a real incentive for PCTs to work with their partners to develop telecare.

**Increased reassurance for service users and carers resulting from the use of telecare will release services from constraints created by risk-averse policies and practices. In doing so, this will enable them to become more responsive to the lifestyles of individuals.**

To facilitate take-up of telecare and assistive technology by the NHS and social-services partners, the Department of Health has adopted a three-fold approach:

- providing initial investment through a range of initiatives;
- working with industry in order to co-ordinate demand for telecare and to inform the development and design of future technologies for the benefit of users; and
- to educate and build knowledge and awareness amongst those who will be commissioning telecare services and those who will benefit from them.

To support the last objective, the Care Services Improvement Partnership (CSIP) in the Department of Health has published an online detailed implementation guide to developing and delivering telecare services.

5.3.1 Partnerships for older people projects

In November 2005, the Department of Health announced the award of funding to 19 pilot projects to support independence for older people in stage 1 of the Partnerships for Older People Projects (POPP) programme. In 2006, 150,000 older people received personalised care under the programme. Another ten pilot projects received further funding in stage 2 of the programme in December 2006.

The programme directly supports key objectives of the white paper *Our Health, our Care, our Say: a New Direction for Community Services* and delivery of the two PSA targets (long term conditions and supporting vulnerable older people). In total, £60 million of ring-fenced funding from the Partnerships for Older People Projects (POPP) was awarded to councils with social-services responsibilities (CSSRs) for 2006–2008 to establish innovative pilot projects in partnership with primary care trusts and the voluntary, community and independent sector.

The pilots are aimed at reforming health-care services to deliver improved outcomes for older people by changing the pattern of service delivery from the focus on acute and intensive care towards earlier, targeted preventative interventions, which should reduce avoidable, emergency admissions and bed-days for older people and improve their well-being and independence. These projects invest in prevention through a range of interventions, which include falls prevention, handy-person services, equipment, adaptations and assistive technologies. The Department of Health is also funding 11 pilot projects on self-assessment by people with long-term conditions for home care and community equipment.

5.3.2 The Preventive Technology Grant

From April 2006, a Preventative Technology Grant of £80m is being provided over two years to enable English councils to invest in the development of integrated telecare services with partners in the NHS, housing and district authorities, voluntary organisations and the independent sector. The funding should increase the numbers of people who benefit from telecare to remain independent at home by at least 160,000 older people nationally. It should also help reduce the number of avoidable admissions to residential and nursing care and to hospital.
The purpose of the Preventative Technology Grant is to initiate a change in the design and delivery of health, social-care and housing services and prevention strategies to enhance and maintain the well-being and independence of individuals. The grant is designed to help councils and their partners address the challenges of a changing and ageing society with increased expectations, such as the right to have choice about services, control over their delivery and the right to be able to live independently at home with dignity for life. Integrating telecare into mainstream services will help councils and their partners to be best prepared to meet the challenges. It is expected that most of the beneficiaries of the grant will be older people.

Another programme – the Whole System Long Term Conditions (LTC) Demonstrators programme – aims to prove that integrated care supported by intensive use of advanced assistive and remote monitoring technology can achieve significant improvements in the health and well-being of people with complex long-term conditions and reduce unnecessary acute hospital and care-home use.

Multidisciplinary teams from local-authority and NHS-led partnerships in Cornwall, Kent and Newham have been awarded £12 million in 2007–08 to develop integrated care plans, and, where appropriate, advanced assistive technology will be deployed in the home to support the provision of care.

The aims of the programme are to:

- help people to maintain their independence;
- reduce the number of prescriptions dispensed;
- reduce the numbers admitted to residential care and nursing homes; and
- reduce emergency hospital-bed days and admissions, and reduce A&E attendances.

The projects will focus on two main patient groups:

- people who are at risk of current and future hospital admission due to at least one of the following conditions: chronic heart disease, chronic obstructive pulmonary disease or type 2 diabetes; and
- frail elderly people who are at risk of current and future hospital admission and have complex health- and social-care needs.

The pilots will run for a minimum of two years and will be on a greater scale than anything undertaken in England to date, since 3,000 to 4,000 telehealth and telecare installations are planned with over 7,000 devices to be set up across all of the sites over the next two years.

The Department of Health is also commissioning a major independent evaluation through its Policy Research Programme. It will look at capturing the lessons from the pilots and determining the best options for the nationwide implementation of whole-systems programmes to meet the needs of people with long-term conditions.

If the results of the pilot projects are positive, this could create a real impetus for the implementation of electronics-enabled assistive technology and telecare devices nationwide, which would stimulate the UK market for such devices.

### 5.4 Research and development

The demographic challenge of an ageing population is stimulating an increasing number of individual research projects and larger joint programmes of work. The government is funding the English Longitudinal Study of Ageing (ELSA), for example, which explores how the dynamic relationships between economy, social and health factors interact over time to affect the quality of our later life.

In addition, the research councils support a wide range of research projects that address the needs of our ageing society, such as New Dynamics of Ageing, an ambitious seven year multidisciplinary research programme concerned with improving the quality of life of older people. A collaboration between five UK research councils, the programme aims 'to develop practical policy and implementation guidance and novel scientific, technological and design responses to help older people enjoy better quality lives'.

### 5.4.1 Key priorities

With regards to electronics, health care, and ICTs, the Department for Business Enterprise and Regulatory Reform (BERR) (formerly part of the Department for Trade and Industry (DTI)) has indicated that the UK should prioritise its research and development (R&D) activities and funding streams around some themes that are of direct relevance to gerontechnology. If this recommendation is heeded, manufacturers of innovative technologies in the fields listed below may gain access to a pool of funding.
Medical devices - assistive technologies/telecare
The Department of Health and the Department for Business Enterprise and Regulatory Reform (BERR) have both stressed that they are committed to working together in order to develop new technologies for health care including assistive technology and telecare.

We want to work further to ensure new innovations are explored, and will offer assistive technology funding to projects which could meet the demands of the future.14

ICT – pervasive systems and ambient intelligence
SAPHE (Smart and Aware Pervasive Healthcare Environment) is an example of a project that received government funding to develop a novel architecture combining wireless telecare networks with miniaturised unobtrusive wireless sensors worn on body and incorporated into homes, hospitals and the wider community. The technology allows continuous monitoring of the well-being of vulnerable patients, such as older people, and gives early warning of emergency situations and long-term health problems.

Electronic devices - sensors and imaging technology
The Technology Strategy Board – a non-departmental public body sponsored by the Department of Innovation, Universities and Skills (DIUS) and charged with executing the government's technology strategy – has recognised that sensors and imaging technology are key technologies that will provide the basis for the next generation of products across a broad range of areas. An indicative £7.5 million of funding has been allocated for collaborative research & development projects (for sensors and imaging technology) that predominantly address healthcare, security, crime detection and prevention and environmental applications.15

5.4.2 Government approach to R&D for medical technology
A range of recent government initiatives aim to streamline health research and support commercialisation of medical innovations. Those developments should facilitate the adoption of new technologies in the health-care sector.

Streamlining health research In response to Sir David Cooksey's review on the best institutional arrangements for a new single fund for health research, the government has established the Office for Strategic Coordination of Health Research (OSCHR) to coordinate health research.

Consulting industry partners The Healthcare Industries Task Force (HITF) has brought together government and industry stakeholders to identify steps to strengthen performance of the UK health-care industry and maximise the benefit to patients from health-care products and medical devices. In March 2007, the task force published Innovation for health: making a difference, which sets out plans for accelerating the use of medical innovation more widely across the NHS. Though this is its final report, one of its recommendations is that a new mechanism is created for future strategic engagement between government and the health-care industry.

Supporting commercialisation Operational since 2006, the National Innovation Centre (NIC) was created to accelerate development and adoption of technological innovations that improve patient welfare. The organisation offers support to developers of health-care technology products and guidance on getting products to market. It aims to put the relevant people in contact with each other to stimulate partnerships between universities, the health-care industry and NHS staff at an early stage.

The NIC works with its partners to identify new technologies based on agreed needs which are then delivered by the nine NHS regional innovation hubs in the areas covered by the English Regional Development Agencies.

Through a stringent assessment process, the NIC considers technological innovations and directs them to the most suitable areas for further development.16

Through the NIC framework, funding was awarded to develop ATcare, an assistive technology (AT) centre in London. The centre is to provide development, regulatory and business support and advice to businesses, universities and the NHS to bring AT to market.

6.0 Assistive technology
Assistive technology (AT) covers products or services designed to extend the independence of disabled or elderly people by maintaining, increasing or improving their functional capabilities. AT products can assist people challenged by physical, sensory or cognitive deficiencies in accomplishing daily living tasks, in communication, education, work or recreational activities. Given the shortage of care workers in the public service and the
escalating cost of providing reasonable standards in nursing and residential care, the Audit Commission notes, ‘New assistive technology has the potential to modernise the way in which many aspects of health and social care are currently delivered to the benefit of users, carers, service providers and the taxpayer.’

Assistive technology is a class containing a large number of devices ranging from mainstream products with inclusive design to products that specifically target people faced with a disorder or impairment. Some are portable; some are fixed. It has not been possible for this report to estimate the value of the current UK assistive-technology market nor the value of electronics-enabled assistive devices, as AT is a cross-over between medical devices, telecare and information and communications technologies. However, the market seems likely to expand in the coming decades driven by technological innovation in ambient technology and robotics.

Table 1 illustrates how AT can support users suffering from a range of different conditions.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Equipment for daily living</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthritis</td>
<td>Equipment for daily living</td>
</tr>
<tr>
<td>Hypertension and heart disease</td>
<td>Wheelchairs; telehealth for remote monitoring of vital signs such as heart rate and variability and body weight</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Orthopaedic footwear; telehealth for remote monitoring of blood glucose, hypoglycaemia alarms and medication reminders</td>
</tr>
<tr>
<td>Hearing problems</td>
<td>Hearing aids, induction loops, text-phones</td>
</tr>
<tr>
<td>Cataracts and other forms of visual degeneration</td>
<td>Visual aids, better lighting, reading magnification cameras and displays, colour sensors, text to sound converters</td>
</tr>
<tr>
<td>Mobility problems</td>
<td>Wheelchairs, walking frames, stair lifts, fall detectors, bed monitors, personal environmental controls</td>
</tr>
<tr>
<td>Dementia</td>
<td>Telecare systems to monitor safety and movement.</td>
</tr>
</tbody>
</table>

Table 1: Assistive technology and the range of user needs that can be supported

The field of assistive technology is advancing rapidly. Dr Kevin Doughty, Deputy Director of the Centre for Usable

Home Technology notes that there are now four generations of devices:
- **Generation 0**: stand-alone devices which help compensate for sensory or functional impairment, such as vision, hearing, smell, balance and memory
- **Generation 1**: reactive devices
- **Generation 2**: proactive life- and health-monitoring devices
- **Generation 3**: advice, information and communications

Generation-0 assistive-technology devices are presented in the list below. Except for prosthetics and orthotics, communication aids, hearing and listening aids, and some mobility equipment such as smart wheelchairs, most assistive-technology devices are stand-alone and use little or no electronics.

**Communication aids**
- speech and augmentative communication aids – devices that provide a means to express and receive communication for persons with limited or no speech. Electronic devices include speech synthesizers, text-to-speech hardware, personal voice-amplification devices and signal systems.
- writing and typing aids including electronic Braille devices, note-taking devices and spelling devices
- vision and reading aids – electronic products include auditory and speech-output devices, reading machines, scanning and document-reading systems, electronic book readers, talking equipment (clocks, watches, scales etc.), Braille devices, Braille-transcription and translation devices, CCTV equipment for magnifying documents and electric page turners

**Computer access aids**
- alternative input devices – electronic products include alternative and adaptive keyboards, expanded keyboards, alternative and ergonomic computer mice and pointing systems, head-operated pointing devices, eye-pointing devices, brain-actuated pointing devices, switches, touch screens, voice-input systems, dictation hardware, ergonomic computer-based equipment, etc.
- alternative output devices such as screen readers, talking browsers and Braille-display hardware

**Daily living aids**
- clothing and dressing aids
- cooking, eating and drinking aids
- home-maintenance aids
- toileting and bathing aids
Environmental aids
- home-automation systems
- environmental control units

Ergonomic equipment
- products designed to reduce the likelihood of repetitive-stress injuries often associated with work-related situations

Hearing and listening aids
- hearing aids, infrared and personal amplification systems, audio-loop systems, TV amplifiers, text telephones, visual, tactile and vibrating alerting systems with trigger units

Memory aids
- audio reminders, automatic pill dispenser, locator devices

Mobility aids
- scooters and buggies, stairlifts, power wheelchairs

Prosthetics and orthotics
- artificial limbs and other orthotic aids including splints, braces, foot orthoses, helmets, restraints, supports, etc.

Recreation and leisure aids
- modified sports equipment, audio description for movies, adaptive controls for video games, other leisure and travel aids

Seating and positioning aids
- products that provide mobility-impaired persons with greater body stability, help them maintain upright posture, provide trunk and head support and reduction of pressure to the skin
- aids include battery-powered mattress inclinators and pillow lifts, powered leg lifters and powered self-lift chairs

6.1 Telecare

Telecare refers to the use of information and communications technologies for delivery of health- and social-care services from a distance to people in their homes or their wider community.

6.1.1 Key features

Telecare generally comprises four components:
- monitoring safety and security, which may involve for example personal alarm systems, bath- and sink-overflow detectors, extreme-temperature monitors, gas detectors and shut-off valves, carbon-monoxide sensors, smoke alarms, light sensors, door sensors, flood detectors, medication-detection alerts, wandering devices, tracking and tagging devices;
- personal monitoring, which may involve for example medical sensors and devices that monitor physiological parameters such as symptom change, oxygen saturation, peak flow, body weight, temperature, blood pressure, heart rate, glucose level and electrographic heart signals;
- lifestyle monitoring, which may involve for example automatic fall-detection equipment, enuresis sensors, pressure pads to monitor bed and chair occupancy, passive infra-red motion detectors to monitor room occupancy and sensors to monitor the use of electrical appliances such as fridges, cookers, kettles and washing machines; and
- information and communication, which may involve for example personalised advice and reminders, for instance, to support medication compliance.

6.1.2 Monitoring devices

Electronic telecare devices range from equipment that allows conscious users to raise an alert at a control centre (by pressing a button or pulling a cord) to devices that monitor an individual’s health or environment and trigger a warning if the person’s well-being has deteriorated or if an incident appears to have occurred. All monitoring devices serve at least one of three purposes: to predict problems, to prevent them or to mitigate harm by raising an early alert. Individuals will not necessarily need all three features of the telecare service at any given time.

Technology providing a response to an immediate need, for example a fall or a sudden change in a person’s vital signs, is sometimes described as response-mode telecare, in contrast to other telecare solutions that either singly or in combination, can provide evidence of a change in an individual’s health or well-being.

Lifestyle monitoring in conjunction with data from the use of electronic assistive technology (EAT) can highlight a reduction in the use of specific devices and appliances, indicating a slow deterioration in a person’s condition. Such information can help carers obtain a better picture of how the individuals are coping within their homes. This technology can be defined as preventative-mode telecare.
The simplest systems consist in a personal alarm system with base unit in the user’s home, which is connected to a telephone line. Alternatively the alarm can be activated by an unobtrusive remote pendant worn around the neck or on a wrist band. The pendant alarm is battery-operated and linked to the care alarm wirelessly, allowing use around the house and garden.

More complex telecare systems generally involve a care alarm fitted to the telephone point and mains power supply along with the sensors needed by a particular resident, and communication devices that connect several monitoring devices together and transfer the data using a standard telephone line. If an untoward event occurs or if there were evidence that vital signs were outside of defined limits, a response is prompted from another person, such as a family member, a neighbour, call-centre staff, a professional carer or other health-care practitioner. Whilst there is a range of wireless systems on the market, at present, the majority of telecare equipment installed under UK pilot projects from health and social-service partnerships does not use wireless technology.

Telecare can provide immediate verbal messages to users, reminding them to turn off taps left running, or take their medications, for instance, so that memory problems can be accommodated while preserving the resident’s control and independence. In addition, some sensors can automatically operate a mechanical response to prevent risks. For example, a sensor may activate a light at night so that the person does not need to reach for the switch in the dark, whilst another sensor equipped with a shut-off valve may be incorporated into a cooker so that the knobs can turn themselves off if unlit gas or smoke is detected.

Another example helps prevent flooding and scalding in the bath. Equipped with a pressure sensor, it releases excess water down the plug hole when the water running into an unattended bath reaches a certain depth by opening a pressure plate; this level is maintained until the taps are turned off. When the desired level is reached the pressure plate will close again leaving a filled bath. The colour of the plastic forming the plug’s sealing plate is temperature-sensitive and gives an immediate visual indication of over-hot bath water to prevent scalding.

Whilst sensors are the main devices installed for monitoring daily activities, other competing technologies could be implemented in the coming decade such as smart phones and PDAs. Radio-frequency identification (RFID) chips could also be used to monitor the movements of elderly people remotely in their homes and ensure that they are not in trouble. The chips can be attached to household objects such as medicine cabinets and fridges for lifestyle monitoring, or to windows and doors for safety monitoring. Currently the cost if tags is one factor limiting the use of this technology.

Additionally, recent research shows that computers could one day track people’s movements around their home by monitoring the electrical noise made by their household appliances as they switch them on and off. The technology, which relies on a device plugged into a single standard wall socket, could be cheaper to operate than a network of sensors, since it would not require the creation of new infrastructure and technology to control them. Applications could include home-automation systems and lifestyle monitoring.

Earlier telecare trials in the UK mainly aimed to provide safety and security for older people through response-mode technology. However, with the current’s government push for chronic-disease management and preventive care, the focus of telecare implementation has started to shift towards increasing personal and lifestyle monitoring.

### 6.1.3 Tracking devices

Technologies such as GSM communications, Bluetooth, global positioning system (GPS) and radio-frequency identification (RFID) have found applications in telecare, to improve the safety of people with dementia (which includes Alzheimer’s disease), and other conditions where people may experience difficulties with their memory.

According to the Alzheimer’s Society, approximately 700,000 people in the UK suffer from dementia, of whom 22% live alone, 36% live with carers and 42% live in nursing homes. Currently, the financial cost of dementia to the UK is over £17 billion per annum. A total of 58,300 patients were institutionalised in 2003–04. At an approximate cost to social services of £600 per person per week, a reduction in institutionalisation of just 1% would save £8.1 million per year.

The prevalence of dementia increases with age. One in 14 people aged over 65 and one in six people aged over 80 years has a form of dementia. As the UK population is ageing, the number of dementia sufferers is set to rise. It is estimated that by 2021 there will be about 940,000 people with dementia in the UK and this number is expected to reach over 1.7 million by 2051.
Wandering is a common problem in people with dementia, and sufferers who go out unaccompanied are at risk of having accidents or getting lost. Wandering causes stress to carers and relatives. It also leads to referrals to psychiatric services and admissions to hospitals and care and nursing homes. In fact, the Alzheimer's Society estimates that wandering increases institutionalisation seven-fold.

Wandering (locator) devices such as mobile phones allow carers to pinpoint the location of the person carrying the device. Depending on the type of device, the carer can locate the person who has wandered via an internet mapping service, text-message service or by phoning a call centre. Most devices allow real-time tracking. Internet mapping services can be accessed from a computer, PDA or other internet-enabled devices. In contrast, in electronic tagging, the tag is usually a wristband. The circuitry in the tag may either set off a boundary alarm or emit a radio signal that allows the wearer to be located by monitoring stations or hand-held detectors.

The use of assistive technology brings ethical considerations. The use of tracking and tagging devices, in particular, has led to some controversy, as dementia sufferers are not in a position to give fully informed consent or refuse to be tagged. In the United States, RFID microchip implants have been approved by the US Food and Drug Administration. However the implanted microchips have not only been used for tracking patients but to access personal information stored in a separate database.

Since dementia can make it impossible for sufferers to pass on vital information when faced with a medical emergency, some institutions have advocated this use of RFID chips for the dementia community. On some occasions, this has led to opposition from family members and relatives. In May 2007, people protested against a care home’s plan to implant 200 patients with microchips, which, when scanned, revealed a unique ID number giving access to medical information held in a password-protected database about its owner.

In the UK, implantation of RFID chips in humans has yet to be authorised, and research on the most acceptable and appropriate types of tracking and tagging systems are under way. There are a number of research projects that aim to explore the views of people with dementia and their carers about the use of assistive technology to ensure safe walking; the acceptability of existing devices to people with dementia and their carers; and how such technology can be improved. It is hoped that the outcomes of these projects will inform policy and new developments.

6.1.4 Main advantages

Since telecare can be customised around individuals and their environment, the technology can be reconfigured to meet the needs of people, which will almost certainly vary as they grow older or as their medical condition changes. By empowering users to look after themselves better and helping them recognise the warning signs when their condition worsens, telecare has the potential to complement the work of clinicians and social-care providers to achieve outcomes that improve the health and well-being of people, especially frail elderly people and individuals whose life and independence might be affected by a chronic disease or a disability. In the future, the technology may become an essential part of an overall care programme that could also include domiciliary care, assistive technology and home nursing care.

Telecare can help older people live independently at home and participate in their community for longer by managing and preventing the risks associated with care outside formal care settings. It can also give carers more personal freedom, meet potential shortfalls in the health and social-care workforce, reduce the number of unnecessary admission to hospitals and care homes, and facilitate early hospital discharges.

6.1.5 Market size and forecast

Whilst the benefits of telecare technology in supporting the independence, health and well-being of vulnerable, disabled and older people has been demonstrated through a range of research activities, pilot studies and ad-hoc trials, and whilst current policy to promote intermediate care and person-centered services makes the case for its implementation more compelling, implementation of the technology is still patchy. If new initiatives like the Whole System LTC Demonstrators and the Preventive Technology Grant have the positive outcomes expected of them, they would accelerate the use of the technology from the current pilot phase into a mainstream technology offered as part of a whole-service approach across regions and care services.

Datamonitor estimated the UK telecare market to be worth approximately US$20.4 million in 2006. However, this
figure encompassed hardware, software and services. Hardware alone reportedly accounted for approximately 31.4% of the total telecare market (US$6.4 million).

Market-research company Datamonitor forecasts that sales of telecare hardware will grow exponentially, reaching US$61 million in 2010 and US$98 million by 2012. This would be equivalent to a compound annual growth rate (CAGR) of 58% from 2006 to 2012. As the driving forces behind such rapid market growth, Datamonitor points to the growing health-care needs of an increasingly large elderly and chronically ill population, the rising expectation of patients who want to have more information regarding their health status and more involvement in their health-care decisions, and the increased financial constraints of the public health- and social-care system. The market-research company believes that systems for monitoring chronic conditions will constitute one of the fastest growing segments.

As the UK telecare market is still very young, it is difficult to forecast its rate of growth with accuracy. Datamonitor’s predictions need to be taken with some caution. Acceptance from clinicians and users as well as device interoperability and improved connectivity are just a few of the conditions that will need to be satisfied if the market is to grow at the pace predicted by Datamonitor.

6.1.6 Telecare vendor landscape

There are currently four main types of suppliers of telecare hardware in the UK:

- specialised and independent telecare technology vendors;
- managed services companies offering both technology and services solutions encompassing equipment rental, installation, maintenance and repair, monitoring and response services;
- general IT vendors; and
- large medical-device manufacturers.

Telecommunication companies such as British Telecom are also entering the market, whilst large providers of managed services may also be well placed to exploit future market opportunities.

6.1.7 Future growth opportunities

The market for telecare is still in its infancy and, as such, it offers new opportunities for manufacturers of electronics-enabled devices. One way to profit from the market is to identify a gap and to produce an adapted solution.

Three areas that manufacturers may want to explore are:

- creating a new monitoring device, for example, for personal monitoring, which could require development of non-invasive alternatives to current invasive monitoring solutions or of a device able to test aspects of a patient’s condition that could previously be assessed only in a formal health-care setting or not at all. Due to innovations in lab-on-chip technology, it may be possible, for instance, to produce monitoring devices that can measure full blood count from small blood volumes, and that can be used at home like the small blood glucose testers that are currently available;
- improving existing systems’ functionality by developing innovative and intuitive interfaces designed around the needs of older people; and
- pursuing profitable niches in the market that may be currently under-exploited; assisted-living accommodation may represent such a market segment.

The advent of new telecare and assistive technology solutions such as self-diagnostic devices and bio-medical implants will especially depend on, among other things, the development of:

- miniaturised biosensors or physiological sensors;
- micro devices with low power consumption;
- standards and interoperability;
- trust and security; and
- personalised interfaces.

The challenge for the next decade is to provide packages of telecare (including assistive technology) which can be customised according to individuals’ evolving needs and easily deployed in their homes. This will be facilitated by developments in a range of core enabling technologies, notably:

- communications (e.g. internet/broadband connectivity, mobile and fixed telecommunications, digital interactive TV (DiTV), Bluetooth)
- digital interfaces (e.g. information presentation, touch-screen technology)
- database and data-mining technologies (e.g. data fusion, smart cards, expert systems, decision support systems)
- sensors and actuators (e.g. wearable/implantable vital-signs sensors, biochemical sensors, environmental control sensors).
7.0 Ambient technology

7.1 Beyond home automation

Home automation, also called ‘domotics’, is the integration of building automation for the purpose of increasing safety, security and comfort to its residents. Home automation aims to give the occupant integrated control over the house and its appliances from anywhere. This control can range from the simple turning on and off of electrical appliances to entirely personalised programmes that coordinate the operation of multiple devices. Automation can cover basic support functions such as lighting, heating, ventilation and air conditioning as well as electrical installations, for example control of doors and window shutters, security and surveillance systems and multimedia home-entertainment systems. Most home-automation systems require a central personal computer to provide control and to run programs. User interfaces are largely image-based and self-explanatory.

According to market-research company Frost & Sullivan, the European home-automation market earned revenues of $230 million in 2006. They claim it could reach $450 million by 2013. Since home-automation systems tend still to be based on wired networks, most of the systems are currently installed during construction or major renovations, and the retrofit market is yet to be exploited.

The next stage in the home-automation market is likely to be the development of systems and components that use wireless protocols, are low-powered, reliable and have high intercompatibility. Advances in ambient intelligence may also improve home-automation systems and facilitate easy living by offering a greater degree of programming and customisation capable of creating the desired atmosphere and functionality via a multitude of intelligent and inter-connected embedded systems and services.

Ambient intelligence refers to a ‘smart’ digital environment that is sensitive, adaptive, and responsive to people’s needs. Still in a conceptual stage, it stems from the convergence of pervasive computing, ubiquitous telecommunication and intelligent devices, and aims to create an environment that recognises and responds to the needs of individuals in a seamless and unobtrusive way, whilst remaining under the control of people.

Ambient intelligence requires a distributed network of interconnected computing devices including, for example, sensors, actuators, interactive screens, displays, digital cameras, RFID tags and input devices for speech, handwriting and tactile information. Microprocessors embedded in a wide range of household objects and consumer appliances enable them to communicate with each other and with the wider world through the Internet, whilst people are able to interact with devices through intelligent intuitive interfaces and smart phones. Eventually, the electrical appliances and electronic devices in the home may respond to voice commands.

7.1.1 Smart appliances

There are already working prototypes and commercial versions of smart refrigerators, washing machines and cookers that have been created to assist people in their everyday life. The appliances are being developed to communicate with other electronic equipments such as phones and interactive TVs and to read RFID tags embedded in food packaging or clothing.

For example, a smart fridge may be equipped with sensors and a reader capable of communicating with RFID tags in food packaging. The information from the tags would allow the appliance to keep inventory and track expiration dates. The appliance may interact with home occupants via an intuitive voice-operated interface such as a talking, gesturing character that helps people to select recipes according to the food that is inside the fridge, suggests menus aimed at finishing food that is about to go out of date, plays a video of the chosen recipe, or recommends complementary items for a shopping list. The smart refrigerator may also be connected to a telecommunication network and might be able to establish contact with individuals by sending an email or a text message to remind them that there is no milk left or to let them know what they need to buy in order to prepare a particular recipe. It could also be connected to the internet and set to automatically order specific commodities such as milk or butter when there are none left.

7.1.2 Smart networked sensors and associated software

Sensors are already able to provide information on objects that are being used in the house and to give ‘behavioural snapshots’ of the activities, or the lack of them, at any time. Research is underway to develop software that can analyse the data gathered by the devices in order to track the time and the frequency of a variety of daily activities. The objective is to create software that is able to anticipate
potential risks or needs and act accordingly. By monitoring behaviours in order to detect sudden changes or anomalies to a daily routine and by taking appropriate measures to respond to a possible danger, the smart environment may be able to give assurance to family, friends and carers that their frail elderly relative, for instance, is living safely and healthily at home.

In addition, by memorising the residents’ typical daily activities, the technology may be able to remind them of regular tasks to perform. This requires micro-electro-mechanical systems (MEMS) that combine smart sensors and actuators, wireless sensor networks, and fuzzy-logic control schemes. The use of monitoring technology will have to be balanced against the right to privacy and the need for prevention against misuse.

7.1.3 Advances in speech technology

Voice-operated devices allow hands-free control, which is helpful for people who find keyboards and touch screens difficult to use, such as people affected by tremors or Parkinson’s disease. It can also be easier to use voice-operated systems to control complex devices than on-screen interfaces requiring users to navigate through a range of menus in order to select the right option.

Speech-recognition and speech-synthesis technologies have improved steadily over the last decades allowing the creation of devices that can convert words to speech and vice versa. However, in order to create a really smart environment, speech technology needs to permit systems to understand what the words mean, and to convert instructions such as ‘turn the bedroom light on’ or ‘switch off the cooker’ into the same command. This requires natural-language processing capabilities. Recent advances in technology takes voice control one step further, allowing a system to interact with a user, by asking questions and responding to the replies.

Most existing systems use a fixed script that follows a step-by-step process to interact with a user, but research projects are currently under way to develop more intelligent and flexible systems that have the ability to learn and adapt, based on the knowledge of the devices and the scenarios faced.

7.1.4 Smart transport solutions

Independence requires mobility, and there is a range of technologies being developed to support older people in preserving their transport autonomy. As our society is ageing, the market for these technologies may grow steadily in coming decades. Older pedestrians could benefit for instance from remote-controlled sensors placed above the ground that transmit data wirelessly and in real-time. The sensors would detect people movements at crossings and would adjust the time of the pedestrian crossing to match the walking speed of slower pedestrians.

Older people could also take advantage of car options that make them easier or safer to drive. There are currently luxury cars that offer night-vision options. They project an infrared image of the road on the windshield. Other top-end automobiles have motion sensors that warn drivers of objects to the side and rear of their cars, or are equipped with a video camera that watches the driver and can automatically brake if the driver is not looking forward. Some car manufacturers have developed vehicles that have adaptive cruise control installed with front-projecting radar responding to road conditions. Recent developments also include cars that can parallel park themselves automatically.

Disabled people would benefit from smart wheelchairs that can be personalised to the individual, have capabilities for autonomous movement, obstacle detection and avoidance, and can be operated through user-friendly tactile interfaces, sensors or voice command.

7.1.5 Smart wheelchairs

Handicapped and elderly people with low vision, visual-field neglect, restricted limb movements, spasticity, tremors or cognitive deficits may find it difficult or impossible to operate a standard powered wheelchair. Due to recent advancement of ambient intelligence and robotics technology, there is growing interest from both the scientific community and industry in researching and developing smart wheelchairs that can help these people to gain mobility and remain independent by reducing the physical, perceptual, and cognitive skills necessary to operate the wheelchairs.

Typically, a smart wheelchair consists of either a standard electric powered wheelchair base to which a computer and a collection of sensors or cameras has been added for obstacle detection, or a mobile robot base to which a seat has been attached. More recently, some prototypes of smart wheelchairs are using advanced motion-control devices based on a DSP chip. Interfaces of smart
wheelchairs vary to cover users’ different mobility limitations. They include joystick, tactile screen, single push button, user’s face direction and voice interface.

Research is being undertaken in order to develop intelligent wheelchairs that can learn to adapt in order to respond to their environment. European funded projects, in particular, are focusing on the biological interaction between humans and robots, and have been looking at constructing a brain-computer interface to allow people affected by a locked-in syndrome and tetraplegia to command wheelchairs.

7.1.6 The way ahead for ambient intelligence

Widespread deployment of ambient intelligence is heavily reliant on technology advancement in order to find solutions to existing problems related to cost, interoperability, accuracy and reliability. As a result, there are a large number of research projects and technological collaborations in the field of ambient intelligence. Current research efforts cover areas such as:

- agent-based computing;
- intelligent and intuitive interfaces;
- smart sensors with capabilities such as signal amplification, analogue-to-digital conversion, self-diagnostics, control logic, memory and bus communication capability;
- unobtrusive hardware devices that exhibit low heat dissipation, consume less power and operate at higher speed;
- dynamic and distributed sensor networks with plug-and-play features that allow instantaneous connection of devices;
- technology interoperability and standardisation from the interface level to implementation and hardware deployment; and
- technology security and reliability.

Driven by a major demographic shift, some forecasters predict that health care and home automation will be the fastest and main applications of ambient intelligence. Home-automation systems with ambient intelligence may enable people to monitor and control from a distance multiple domestic appliances and electronic goods from refrigerators and washing machines to cookers. Another aspect of ambient intelligence is to support socialisation and to enhance the quality of life for individuals who would otherwise lead solitary lives at home. Until now, this area of ambient intelligence, however, has been relatively neglected.

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Age Concern England
Alzheimer’s Society
Association for the Advancement of Artificial Intelligence Centre for Policy on Ageing
Department of Health
Department for Business Enterprise and Regulatory Reform
Foundation for Assistive Technology (FAST)
Help the Aged
Joseph Rowntree Foundation
National Innovation Centre
Office for National Statistics
The Government Actuary’s Department (GAD)
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