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Design for Ageing and Well-being: Integrating Arts and Technologies

The New Dynamics of Ageing Programme (NDA), established in 2005, is the first occasion that five UK Research Councils have combined to mount a multidisciplinary research programme on any topic. With funding in excess of £22 million, it is the largest research initiative on ageing ever mounted in the UK.

The pressing need to tackle the multi-faceted problems raised by the forecast doubling in the number of elderly across the developed and developing nations (COM, 2004) has resulted in this collaboration which is focuses on consolidating expertise across the domains spanned by the:

- Arts and Humanities Research Council (AHRC),
- Economic and Social Research Council (ESRC),
- Engineering and Physical Sciences Research Council (EPSRC),
- Biotechnology and Biological Sciences Research Council (BBSRC),
- Medical Research Council (MRC).

Its aim is to reveal the dynamic interplay between the ageing of individuals and their changing technological, cultural, social and physical environments - local, national and global - and to develop methods and means for overcoming the consequent constraints on the quality of life of older people [NDA 2005].

Within the overall programme aims of improving the quality of life of older people and re-balancing the use of evermore scarce human care resources, this project addresses the topic area of ‘Ageing Well Across the Lifecourse: Autonomy and Independence’ - with a particular focus on Active Ageing

Context

The objective of this project is to determine how best to provide the ageing population with easy access to appropriately personalised “Smart Support” broadly regardless of wherever they may chose to be or whatever they wish to do. As such its main aim is to obviate, as far as reasonably practical, the inevitable impacts of growing physiological and cognitive impairment that comes with the ageing process

Although considerable effort has so far been expended on trying to develop solutions to discrete problems often in highly focused domain “silos”, little progress has been made when viewing the wider picture from a strategic apolitical perspective. Despite the best of intentions the approach to date has tended to centre on collated opinions of conclaves of professional specialists and focus groups, rather than on objective across-the-board research.

With the help of initial seed-corn funding from the NDA the initial phase of the project developed an extensive cross-disciplinary, cross-domain network to unearth:

- the many key concerns of the elderly;
- their problems/strategies of coping with increasing/multiple impairment
- their lifestyle characteristics, interests and range of activites
- the critical psychological factors that affect any acceptance of support;
- the preparedness to explore/accept benefits of change by the elderly
- the perceived needs/preferences for support by the elderly
- the care professionals/carers perceptions of the needs of the elderly
- the range of available support technologies, techniques and systems
- the degree of interoperability between the human, organisational and multiple support technologies
- the degree of understanding of the potential for improved cross-disciplinary support and inter-working using appropriate technologies

The outcome from this phase not only exposed the lack of cross-disciplinary understanding of professional practice and semantics - as well as a past tendency to consider the elderly as disassociated service recipients – but also developed a shared vision and commitment to bridge these gaps.

Concept

This centres on the recognition that the key to continuous access to support is that garments can act as a vital “go-anywhere” communications “platform” [Fig.1].

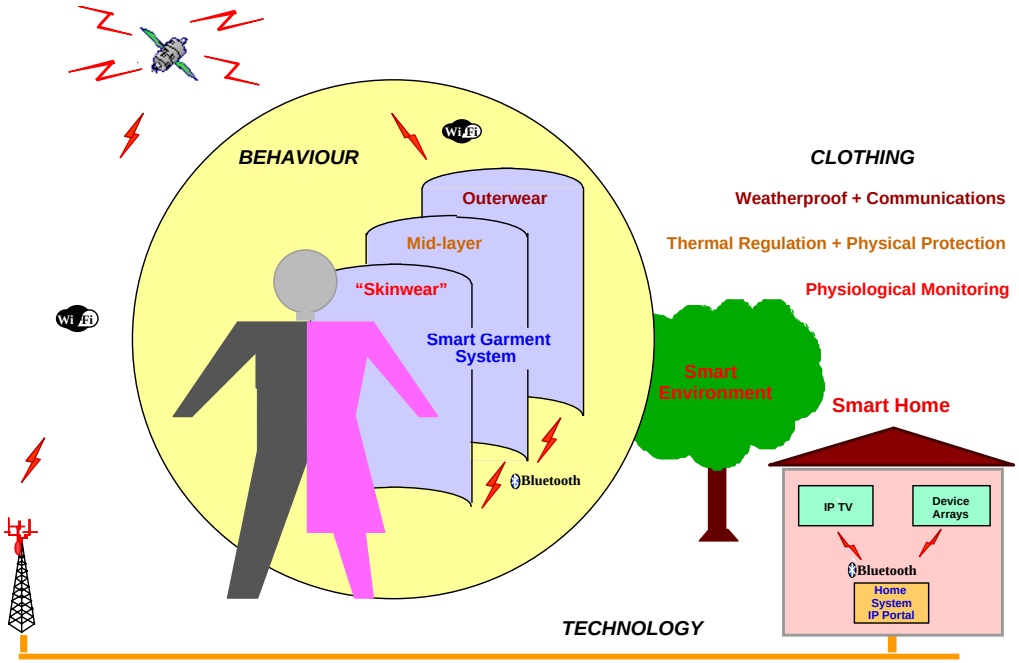

Fig.1 Ageing Well Concept

The creation of a “Smart Garment System” that combines leading-edge textile technologies and manufacturing techniques with those from the world of micro-electronic devices, communications and computing, immediately frees the wearer from any dependency that they might have had on their “Smart Home” into the open arena of the “Smart Environment” (Manning, 2008).

Whilst this convergence of technologies provides a basis for a new industrial revolution, it can only be successful if its potential benefits are attractive and evident for all to see, recognise and chose to engage with. Although this is effectively a truism well understood by the fashion industry, their long term lack of major interest in the elderly could seriously hamper any substantial acceptance by this “grey” market.

This is equally true for the electronics and medical devices arenas, who for a long time ignored the aspects of aesthetic appeal and persisted in supplying products in beige boxes with little consideration for the interests of their human users. Happily Apple changed all that with an injection of style consciousness across its existing product range and its entry into the media markets with the iPod.

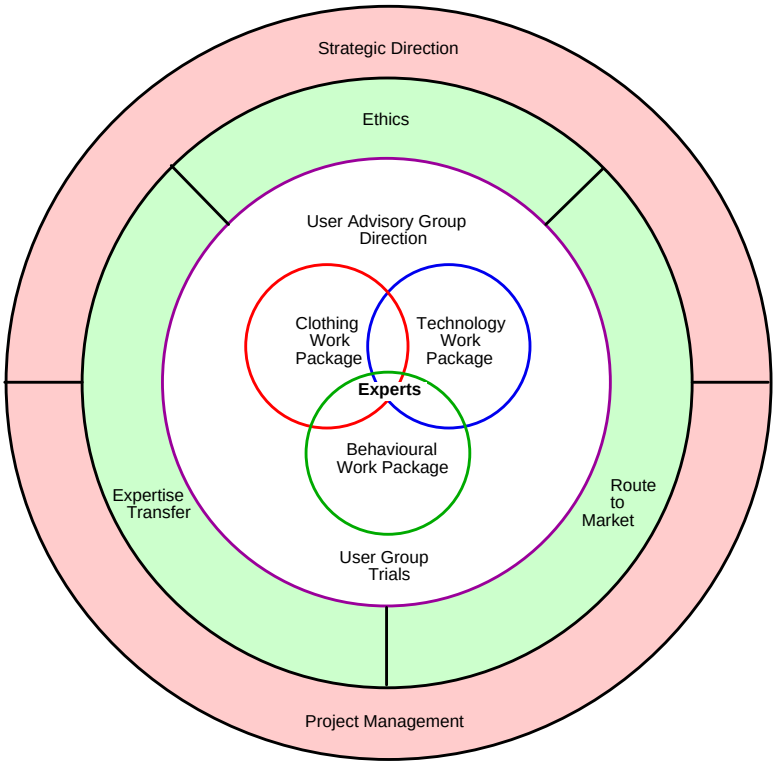

Fig.2 NDA Project Structure

As a result of the initial networking input it became evident that this proof-of-concept project would need to be based on three key interacting Work Package elements [Fig.2], namely:

- Behavioural Psychology Motivation/Preferences/Choice
- Multi-layered Garment System Outer/Mid-layer/"Skinwear"
- Technology Infrastructure Mobile Communications/Infrastructure

Whilst the Multi-layered Garment System is the central core of the project, it will be will be greatly influenced by inputs from the Behavioural Psychology component which will provide significant insights into the motivational and personal preference profiles on which ready acceptance of the garment will depend. By contrast - from the wearer's perspective the Technology aspect will need to be deliberately more muted – albeit that it will be an equally vital aspect of the overall design (McCann et al, 2008).

The key consideration that runs across all three domains is that the elderly need to be an integral part of the design process – and not just the recipients. To this end they not only need to have a key controlling interest in the design aspects of project, but also recognise that this is so.

As such an Advisory Group will be recruited to take an active role in the complete evolution of the research process. Out of these a limited number of volunteers will be selected to join the Trials Group

who will act as “customer” models for the design, manufacture and test usage phases of bespoke full garment system sets.

The selection criteria will aim at establishing appropriate subgroups that reflect a representative sample range of the size and shapes for both genders, and will be subject to the usual ethical control rules. Along with the rest of the project team they will be asked to assist in the transfer and dissemination of experience gained and offered the opportunity to support the route to market.

The ultimate aim of this final stage will be to have formulated a shared inter-disciplinary language and concept that can be effectively communicated to demonstrate how to successfully develop of clothing products that may be worn willingly by older people.

Behavioural Factors

From the outset of the project it was recognised that its success would hinge on understanding and responding appropriately to the many and varied psychological, motivational and practical impacts that the ageing process has on the elderly. Since such research information that there is tends to be very domain specific – reflecting the inevitable “silo” tendencies of disciplinary and technology led interests – the need to establish a cohesive boundary crossing view of this research space was seen as imperative.

The key issue is therefore to invert the traditional approach of developing a product or service from the supplier perspective and drive the development from the point of view of reasonably informed users seeking a personally acceptable solution. In this case a representative set of users need to play an integral part of the development.

This should not be a semi-isolated point of occasional reference such as a focus group, but with a direct impact in the strategic and day-to-day decision-making process and progression of the project. In essence this group would be no different from any of the other project teams, with a team leader acting on their behalf from an organisational point of view.

However this has to be set in the wider context of an in-depth understanding of the variety of needs, major behavioural traits and psycho-social dynamics of this rapidly expanding segment of the population. Whilst this can draw on the varied sources, its start point is the semi-traumatic lifestyle change from a stressful work-lifestyle balancing scenario to one where to old certainties have been replaced with those of avoidance – for as long as possible – or coping with the inevitable creeping impairments and needs that come with the ageing process (Manning & Kun, 2008) [Fig.3].

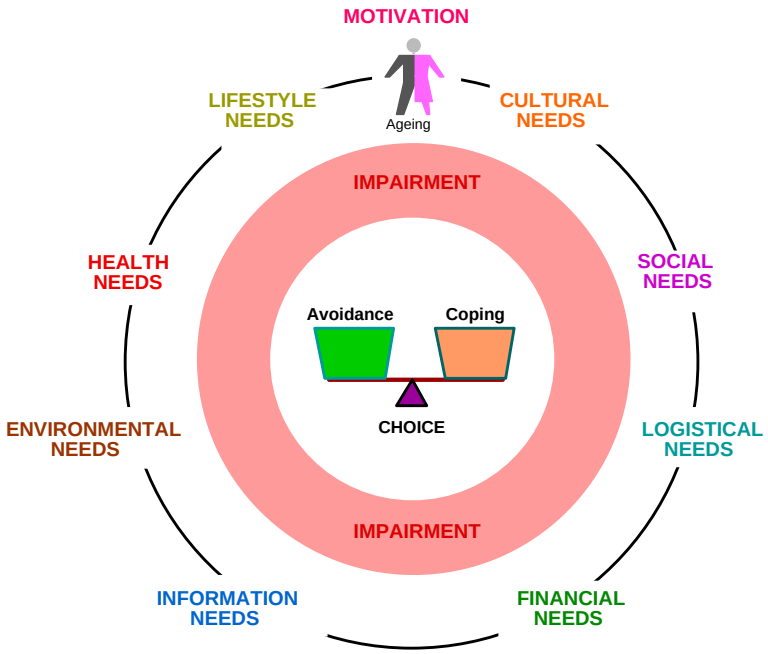

Fig. 3 Behavioural Factors

Although needs are more frequently perceived, assessed and classified by a whole range of professionals involved in the care delivery process, motivation and personal choice mechanisms used by their clients are often neither recognised nor understood. Unfortunately this problem-focused approach often works against a successful dialogue and collaborative acceptance of well-intentioned help by the elderly.

In order to avoid such pitfalls the aim is to focus on identifying the key factors that influence the choice and decision criteria used by the elderly through the ageing process cycle, together with the changing motivational issues that affect and underpin this. This in turn has to be set in the context of changing need – viewed in particular from the perspective of the elderly – but also set in the often more objective external perceptions of accessible and achievable benefits that could be acquired.

The initial phase of this project segment will focus on drawing together a set of demographic, lifestyle and needs assessment framework profiles based on an analysis of the various classification systems developed for use across this complex field. This will be used, together with input from other research sources, to set the basis for a major study of psycho-social and social-economic factors that affect the health, lifestyle and preferences of the ageing population.

It will also seek to establish how they believe that inconveniences of ageing could be reduced or ameliorated within the home and in the wider community environments. Central to this would be their views on how the clothing sector could respond far more positively to their needs in terms of functionality, form, fit and fashion to support an active, more convenient and self-confident mode of living (McCann et al, 2005).

Whilst similar input is needed as regards connectivity and other assistive technology issues, a different approach will be needed, as the majority will be unlikely to be aware of the potential benefits available. In this situation the focus must be on “what if” situations that reveal desired or desirable benefits that point to potential functionality requirement – that probably already exist (AAL, 2008).

The intention is to use a mixture of proforma questionnaires and semi-structured interview techniques to survey the situations and perceptions of as large and disparate section of the ageing population as possible. Its objective is not only to use its output to “set the scene” for the ongoing Smart System development, but also to recruit a cohort of volunteers who can become directly involved in the Garment Layering System development process.

This approach also has the additional merit that it provides the basis for creating and maintaining an extended network of interested and involved parties that can continue to provide valuable feedback to the research team as the project progresses.

Smart Garment System

As briefly outlined earlier [Fig.1] the aims is to develop a three layer garment system set that integrates sensor and communications technologies (Dunne et al, 2002) within those of sophisticated smart wearables that comprises:

- "Skinwear" — Physiological Monitoring
- Mid-layer — Thermal Regulation & Physical Protection
- Outerwear — Weatherproof & Communications

Although the immediate focus is the support of the active ageing, who have an age range spanning 60 - 75 years, and wish to continue to enjoy a reasonably fit and healthy lifestyle, the concept is equally applicable with minor variation to the less well, less mobile and increasingly impaired. All that changes is the degree and types of functionality required of the garment system itself and also of the in-built devices and communication links both between layers as well as external sources.

Of necessity the garment system will need to accommodate the variety of body shapes, sizes and postures that result from the ageing process and its accompanying varying degrees of physical impairment. This not only involves issues of wearability and comfort, but also the use of fastenings and relative ease of dressing/undressing.

These design facets come together through the ingenious use and integration of differing textile technologies. Typically variable stretch textiles can be used to allow enhanced movement without loss of shape - greatly easing the process of donning and doffing garments for the elderly who suffer from rheumatoid arthritis (McCannn et al, 2005[2]).

The use of a range of special fibres, fabric constructions and ventilation methods are key to improved thermal regulation and moisture management that are central to protecting the elderly from hypothermia. Similarly phase-change textiles can help to regulate excessive temperature swings and protect or even warm the lower back area.

Moreover similar structures can potentially now provide lightweight impact protection, which harden instantaneously on impact, absorb high stress loads on the body, and afterwards relax and revert to their original fully flexible condition (Krebs et al, 2005). Their potential to radically reduce the level of pain and anguish – or even death – inflicted through falls by the elderly, who are inherently more susceptible to hip and other traumatic fractures would be immense.

Whilst the combined functionality of the Smart Garment System together with its associated wearable electronics can deliver a wide variety of valuable support services, its aesthetic appeal will be critical to its acceptance by the elderly community. Not only must it be good it must look good and feel good.

3D Body Scanning technology will be used to ensure an optimum fit for all the range body shapes within the selected trial group. Each garment layer will then be designed to co-ordinate style, shape, fit, proportions and ease of movement appropriate to each individuals activity profile – all geared to maximise the wearer's confidence and sense of well being (Loker et al, 2005).

"Skinwear"

Working outward from the body surface the first layer incorporates a range of physiological monitoring devices, precisely located for maximum signal quality within a 3D knitted vest (Hunn, 2007). These device arrays are individually linked via conductive or optical fibres are back down to a Bluetooth communications micro-module. This in turn either forms part of a wireless link (Miller, 2001) between the garment layers or provides a short-range link to a local base station within the wearer's Smart Home (Roe, 2001).

In certain circumstances location monitoring may also be incorporated in addition or even replace physiological sensors as appropriate – particularly as 'wandering' due to early stage dementia is a major concern. A further objective is to provide an open voice communications emergency channel link – similar to the "mayday" channel used by shipping until recently. This would replace the seemingly universally hated alarm pendant that is all too frequently not being worn when an emergency occurs.

All such monitoring must be subject to strict ethical controls from both clinical and privacy perspectives using a variant form of the Informed Consent procedures for invasive surgical interventions. Similar ethical clearance controls will be applied to all garment trials especially where health and hygiene criteria issues are involved.

Mid-layer

The next intermediate layer will combine a variety of protective functionality whilst not compromising appearance or the style requirements of the wearer (Scott, 2005).

Dependent on individual needs garments may incorporate a varied range of textile functionality, such as:

- autonomous self regulating thermal and moisture removal properties
- textiles with intrinsic “memories” that stretch and return to shape
- phase change materials that instantly change characteristics in response to given stimuli

The same communication and location aids used in the vest can be repeated in this layer although the physical links will have to be embedded differently within the fabrics used to make up the garment. Dependent on the degree of possible miniaturisation of these devices it may be possible to dispense with physical links and use wireless Bluetooth connectivity instead

Outerwear

The final outer layer will be designed to cope with the range of environmental conditions that would normally be encountered within the UK. This would use lightweight waterproof and breathable textiles with appropriate finishes, cut to provide optimum comfort and style.

In addition to its primary smart wearable role this layer will act as a mobile communications broadband IP hub concentrating Bluetooth communications traffic with the other layers and providing a WiFi link to external services; for situations where use of outerwear is inappropriate, but external links need to be maintained this functionality will be repeated within the Mid-layer garments (IDC, 2008).

The additional communications functionality envisaged for use out in the wider environment centres is that of GPS-enabled broadband linked mobile phone providing access to a evolving range of location, information and support services. The aim is to use the same approach pioneered in the Apple iPhone – but to distribute its main components appropriately across and within the garment structure.

However this will depend on emergent technological advances that will enable:

- the keyboard to be dispensed with
- a fully flexible screen built into the forearm of the jacket
- the use moulded textile electronic control assemblies
- harvesting of power via built-in flexible solar panels

This will additionally allow the wearer to access a growing variety of map-based services to assist in travelling by public transport, roaming within the community, and locating required facilities in unfamiliar localities.

The incorporation of GPS provides the added benefit of being able to locate anyone who is incapacitated in anyway whilst away from home – especially those who rightly fear the day when memory loss or visual problems may strike and leave them stranded. In such circumstance a support service centre can either guide them home or call in help to collect them.

Garment Development

As outlined earlier the intention is to interlace and extend the work of the behavioural study team to:

- help recruit volunteers from their initial survey group to take an active part in the development process
- investigate occupational interests and physiological protection needs of the active ageing

This will complement the work of the garment development work package team to create a generic design framework for bespoke application [Fig.4]

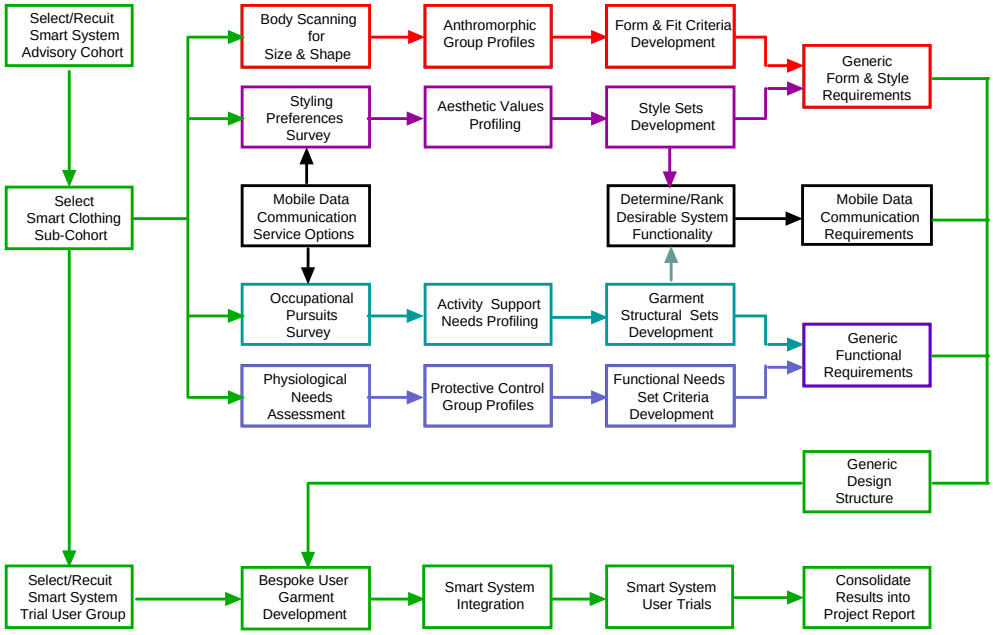

Fig 4. Garment Development Research Programme

A further key input to this design process will be provided by the technology work package team in terms of:

- an easily understood means of presenting the possible service options and their potential benefits to the advisory team and its network
- a ranked set of desired/desirable user service functionality derived from comment and feedback from the advisory team

The garment development team will base their work on 3D body scans of a smart clothing sub-cohort of volunteers selected form the larger study group and matched against the SizeUK data to provide a representative sample of figure types. This will be used to establish a form and fit design criteria that will be brought together with the output of style and aesthetic studies and combine functional requirements to form an overall generic design structure from which to manufacture bespoke trial garment sets.

Life-style and health improvement

Countering or avoiding “creeping” impairment is the goal in effective self-care and resides in the hands of each of us. Achieving this comes down to personal lifestyle choices and self-control predominantly focused of exercise and diet linked together with sensible behavioural habits.

Maintaining this needs support – particularly in providing feedback both at home and on the move - on current fitness plus guidance in “bit-sized” improvement options. For the active ageing taking part in a range of outdoor activities this can follow a scaled-down version sports “training” aids delivered via through their Smart Garment System.

Whether in use at home or away the generic approach centres on individuals planning and managing their own destiny in response to an appropriate mix of physiological and behavioural advice triggered by regular status monitoring [Fig.5].

A useful visual feed back mechanism is a “radar plot” with results for differing characteristics plotted radially with scores normalised in the range outward from good at the centre to bad at the rim. When these are linked to form a “scab” showing overall current status – the aim being to shrink it back into a safe zone (Manning et al, 2008).

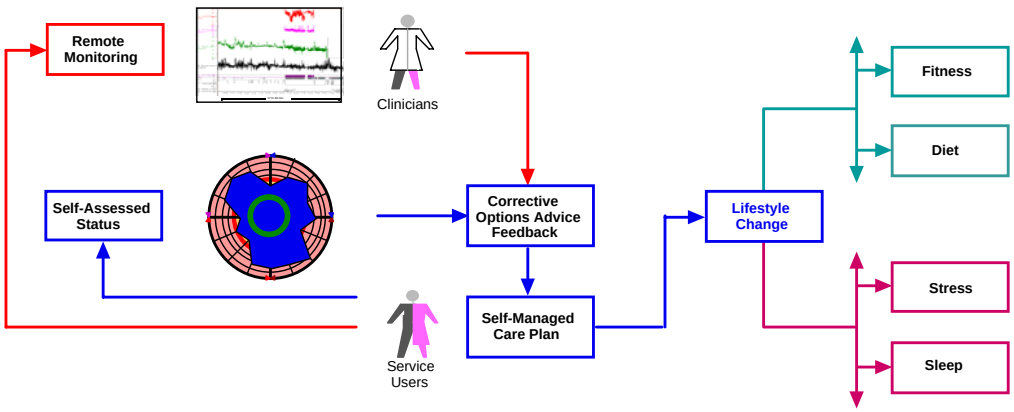

Fig.5 Lifestyle Improvement

Technology Infrastructure

This approach based on a rationalisation of the somewhat fragmented Smart Home concept that has slowly been evolving over the last two decades – and has begun to be taken up as the problems of the demographic “time-tomb” have become apparent to community care service providers. This has been dogged by a general lack of acceptance by the elderly - probably due to their unpreparedness to spend savings on technology that they neither understand, nor believe that they need or could benefit from.

At its technical core is broadband IP connectivity that can carry a widening range of interactive services via a Home Portal that acts as a hub for the incremental expansion for required functionality. Within the home visual access and control is via IP enable TV – with exactly the same functionality available via the Smart Garment System to the wearer wherever they happen to be [Fig.6].

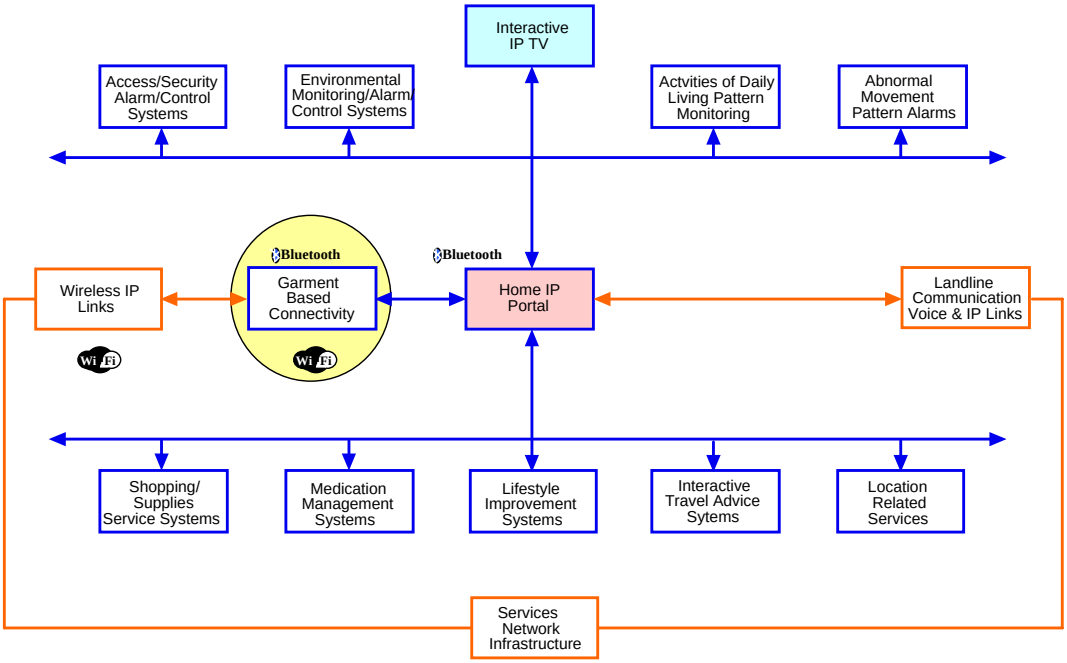

Fig.6 Smart Support Service Infrastructure

This connectivity will ultimately be through the portal – either via Bluetooth links within the home, or routed back by landline through the relevant network infrastructure from the WiFi link in the wearer’s clothing.

Conclusion

The key objective of this project is engage directly with the elderly – giving them an active role in developing something that they want, need and can relate to – in terms of clothing styled for them with useful extra added value.

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