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HADRIAN meets AUNT-SUE.

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Abstract

HADRIAN is a computer aided design tool, developed to support designers in their efforts to ‘design for all’. Combining a database of individuals together with a task analysis tool HADRIAN provides a virtual group of 100 people, ready to perform a user trial at any point throughout a product's design. Developed initially to predict design inclusion for localised design problems such as those experienced in a kitchen environment, HADRIAN is now being developed to include transport data as part of the AUNT-SUE project.

AUNT-SUE is a transport related project that is funded as part of the EPSRC’s Sustainable Urban Environment programme. The project addresses policy making through to design and implementation in its aims to support effective socially inclusive design and operation of transport systems. Part of the AUNT-SUE project addresses exclusion faced by people whilst making a typical journey including: the inability to access adequate route-finding and timetabling information, problems accessing transport infrastructure (bus/tram stops, cycle routes, railway stations etc.), getting on and off transport, and managing interchanges between different transport types.

This paper discusses the development of the relationship between HADRIAN and AUNT-SUE. Initial work focuses on additional data for the database covering transport related tasks. Later work will focus on improving the task analysis capability of HADRIAN whilst integrating the transport related functionality. Ultimately the project also provides the opportunity to further develop HADRIAN towards the needs of designers developing products that maximise social inclusion.

Introduction

HADRIAN (Human Anthropometric Data Requirements Investigation and Analysis) is our inclusive design support tool. HADRIAN was developed as part of the Engineering and Physical Research Council’s (EPSRC) Design for All element of the EQUAL (Extending Quality Life) programme. The main focus of the work was to address a number of concerns in the areas of design and ergonomics that were directly relevant to informing and supporting designers in their efforts to design for all (Porter et al, 2003). These concerns all relate to the need for designers to be able to predict multivariate accommodation, and can be summarised as follows:

- The provision of relevant, accessible and holistic information on people of a broad range of size, shape, and ability
- A means of utilising the available information to assess the inclusiveness of a proposed design.
For design for all, or inclusive design, it is helpful to take a design perspective that considers design problems within a task based context. If we consider the use of any design, it often requires a range of interactivity. Furthermore, this activity is rarely performed in isolation. Thus, the use of a cash dispenser requires the user to view and interpret the screen, to reach and operate the controls and to collect the cash and receipt. However, all of this is done in the context of needing the cash which leads to how the user accessed the cash dispenser, and what they might encounter when they come to use the cash. All of these activities present multivariate accommodation problems for the designer. If any one element of these tasks cannot be completed by the user they are effectively ‘designed out’.

In response to these concerns HADRIAN consists of two main elements. The first is a database consisting of physical and behavioural data on 100 individuals covering a broad range of ages and abilities (Figure 1). The sample is deliberately skewed towards the older and disabled population to offset the relatively well understood younger / able bodied population. Data are available on anthropometry, joint constraints, background information and also notes on any disabilities and problems experienced with activities of daily living.

Figure 1. The HADRIAN database showing anthropometry, joint constraints and task capability.

In addition to the range of anthropometry and joint constraints the system also contains task based data. This covers a range of kitchen based tasks and a number of seating scenarios.
which can also be broken down into more generically applicable elements. Where possible data reflects the real-world experience. Thus, comfort maximums were recorded to reflect what the subject would be likely to do in their own home where absolute maximums would not normally be used. In addition, tasks that represented hot loads such as lifting items into and out of the oven were performed using oven gloves to represent their affects on capability and behaviour.

Task data stored within HADRIAN includes a success or a failure for each task element. In addition, that data not only records whether a task was completed, but also how it was completed. This behavioural element is a key part of the HADRIAN mechanism for predicting accurate postures in task situations. It could be argued that as long as the system predicts postures that the individual could adopt the results would be valid and useful. However, older and disabled people often develop coping strategies for dealing with their reduced capability. These coping strategies make it much less predictable what an individual might do and subsequently what they might be capable of for any given task. Thus, we believe it is equally important to capture and then predict the capability and behaviour of an individual in a virtual fitting trial (Marshall et al, 2004).

**AUNT-SUE**

The next phase of our research is being undertaken as part of the AUNT-SUE (Accessibility and User Needs in Transport for Sustainable Urban Environments) consortium. AUNT-SUE is part of the EPSRC’s SUE programme. The consortium consists of members from London Metropolitan University, University College London, Loughborough University, Camden Council, Hertfordshire Council, and the RNIB, amongst others. The consortium’s aim is to produce methodologies for sustainable policies and practices that will deliver effective socially inclusive design and operation of transport. HADRIAN is one element of this package.

The initial development of HADRIAN addressed localised design problems in response to surveys conducted with 50 older and disabled people (Oliver et al, 2001), in which we asked them how design could improve their quality of life. The two primary responses were in being able to prepare meals for friends and family and being able to use local transport. This lead to a focus on kitchen based tasks and a range of seating scenarios for initial data collection. Taking a pragmatic approach the data collection focussed on tasks that were sufficiently specific to be relevant to design needs, yet generically applicable so that we were not designing a kitchen design tool, or creating a system that required data on every possible task situation to be applicable. In addition, ethical considerations and project resources required that we limit the scope of our study to a manageable size, both for us as researchers and for the data subjects.

As part of the AUNT-SUE project HADRIAN is to be developed further, to broaden the content of the database and to increase the functionality of the task analysis to incorporate transport-related data. Not only does this expand the applicability of the tool into a very interesting and important area but also allows us to address the second of our responses gained from the surveys.

The system will still work with a prototype database of 100 people. As we will discuss later, there are issues around the size of the database. However, for now we intend to maintain the size and expand the data sets for each individual. This poses some logistical problems in trying to use the exact same people again, and it is likely that we will have to replace some of the original 100 with new people, but we feel that it is important that each data set is complete.

The existing data for each individual will be supplemented by additional transport and travel related task data. A comprehensive specification for data collection has yet to be confirmed but it is likely to include data on ingress and egress of a range of vehicles such as taxis, trams, trains and buses. This will also include a range of step types to reflect the variety of outdoor
steps, steps from kerbs to vehicles, steps from platforms to trains etc. Additional data will be collected on door releases, seating, ticketing machines, public toilets and general barriers and obstacles found in public places.

These data will still be related to physical design problems. HADRIAN and indeed, most ergonomics design and human modelling tools such as SAMMIE (Porter et al, 1999), work within the physical realm. However, as part of the AUNT-SUE project our aim is to expand the database beyond the physical into cognitive, emotional and sensory data associated with travel. These data will be looking at the individual’s ability to deal with tasks such as route planning, dealing with crowds and the effects of crowding on the transport design, understanding signs and other public information under conditions of high visual noise, issues with lighting, and the effects of perceptions of crime and personal safety. All of these elements are complex problems to understand and, in particular, to manipulate into a useable data resource. However, they are often some of the most fundamental issues when people are excluded. Thus, if we consider the design of an ATM, the ATM may be highly inclusive accommodating a broad range of users yet when placed in its operating environment it fails to be inclusive due to the dark and secluded location dissuading users from attempting to access it. Alternatively, a perfectly accessible train design may exclude users who cannot reach the train due to poor signage, or timetabling.

The whole journey approach

As mentioned previously, HADRIAN has been developed to address localised accessible design problems. However, the concept of accessible transport is not solely related to any single design, rather it concerns a network or system of designs. This network is part of the transport infrastructure, combining a number of directly related, and indirectly related design problems that must be addressed holistically if accessible transport is taken in the context of the ‘journey’.

The journey is part of our perception that accessible transport is there to enable users to travel from one place to another. To succeed in providing accessible transport we must be able to ensure that our door-to-door journey for example, from home to the doctor, from the bank to the theatre, or from the airport to a relative’s house, is possible at every stage.

As part of the AUNT-SUE consortium two test-bed sites have been identified: in the London Borough of Camden and in the County of Hertfordshire, both of which have council representatives on the project. As part of our whole journey approach we will use the test-beds to identify a number of relevant journeys from which we can collect data. The journeys will be based on observation and real world experience from people in the area and will include all of the accessible design elements that the individuals will have to deal with on those journeys. In particular we will identify the potential barriers faced by the people who make these journeys (Figure 2). These barriers may take many forms and are likely to include a range of: kerbs, pavements, slopes, steps, street furniture, cash dispensers, ticketing machines, lifts and escalators, toilets, transport types, and so on. Clearly, many of these potential barriers may be interacted with in the course of making a typical journey and if any one prevents the user from achieving a relatively small part of the overall task it may well prevent the journey from being possible.
It is intended that developments to the task element of the HADRIAN system will also take this whole journey approach. Individual designs will still be the main focus of evaluation but they will be taken in the context of the journey and the designer will be able to evaluate the accessibility of a particular journey rather than have to consider each element in isolation. This approach should then provide a much more realistic evaluation of the social inclusiveness of any transport system.

**Future challenges**

The aims set out for the HADRIAN component of the AUNT-SUE project pose some significant challenges. The first of these is the development of a technique to evaluate a journey. HADRIAN currently employs a task based evaluative mechanism that requires the designer to define a series of activities for the virtual users from the database to perform (Marshall et al, 2002a & b). The definition of a journey will then add an additional layer to this task framework. As with the initial development of the task definition, one key element with be the intuitiveness of the system and avoiding placing too significant a burden on the designer. It is possible that the system will take a template approach to common design evaluations, automatically providing a task definition that only requires checking by the designer. This then leaves the designer free to focus on any new or particularly complex areas of the design.

The second significant challenge is the incorporation of non-physical evaluations into the process. Whilst presenting these data in the database is relatively straightforward and strengthens the empathy that the designer will be able to gain with the individuals in the database, it is the ability to factor these into the task evaluations that offers the greatest potential step forward. If HADRIAN was a significant step in improving the support for designers in an inclusive design context, then the ability to evaluate the emotional, cognitive, and sensorial...
effects on a design will be an even larger step. Initially, these effects are likely to be addressed through a look-up table arrangement where parameters are compared to a matrix of data in the database and a judgement made on the referenced value, with more advanced solutions left for future work. Whilst this is not an ideal evaluation of these important effects it does bring their attention to the designer and offers evaluation of various scenarios even if only to a limited degree.

The third and ongoing challenge relates to the size of the database. We believe that the philosophy of maintaining the data as individuals is sound with many benefits over more traditional approaches such as percentiles. However, one question that remains is how many individuals are enough? As yet we are unsure, perhaps 1000? Part of the challenge may be in moving to a different way of thinking. Being familiar with population data and the way in which it works, we inevitably try to impose a similar emphasis on the individuals approach. Thus, we consider how representative the database is and how many individuals we need to be representative of the whole population. In truth no number is likely to be sufficient. The alternative is that we begin to filter the population and select people at the extremes to ensure we get a breadth of people within the database regardless of number. However, it could be argued that this moves us back to a percentile philosophy and we could have synthesised these people from existing data. At present we would argue that rather than attempt to be a population based tool, HADRIAN is a virtual user trial tool. As such, it uses a manageable number of virtual people that are as close to the real thing as is presently possible and these people are available to the designer to perform user trials at any time throughout the design process.

The final challenge is in making the tool itself accessible. The original HADRIAN project got feedback from a number of designers but never really had the resources to fully implement suggestions to the necessary degree. However, the AUNT-SUE project provides an opportunity to address usability and, in particular, the interface towards the needs and working practices of designers. It is clear that any benefit that HADRIAN might bring to inclusive and accessible design is only as good as the take up and use by those who actually do the designing of these products, environments and systems.

**Conclusion**

HADRIAN has been developed to support designers in efforts to design for all. The original research that produced HADRIAN proved the concept of the novel approach of maintaining ergonomics data as individuals and supplementing this with additional background information to provide empathy with these individuals. In addition, the ability to then employ these individuals in virtual user trials provided a potentially quick and easy method for obtaining the kind of feedback you could expect from a real user trial. Furthermore, this feedback could be obtained during the early stages of design when the cost and time implications of finding a user group and building a full-size mock-up would be prohibitive.

The AUNT-SUE project draws together many initiatives with the single focus of accessible transport. HADRIAN will be further developed towards this aim with an expanded database incorporating transport related data and an enhanced task analysis tool that will provide the ability to evaluate a whole journey. In addition to the physical data, HADRIAN will be further expanded to incorporate cognitive, emotional and sensory data that can have a significant impact on accessibility and the inclusiveness of a design.

Finally, the AUNT-SUE project also gives us the opportunity to develop HADRIAN beyond an initial prototype into a useable system. A system that not only addresses the need for
applicable data and a method for employing such data, but also one that is sympathetic to the working practices of the designers who will actually use the system.

References


