

M. BRINK, J.E.M.H. VAN BRONSWIJK. *Home automation middleware and user needs. Gerontechnology 2010;9(2):199*; doi:10.4017/gt.2010.09.02.232.00

Purpose Middleware of home automation systems, or ICT infrastructure, forms the backbone of home automation systems. It can be seen as the network of a home automation system. Between home automation components, it defines the technologies used for communication. Home automation systems may include assistive technologies, fun technologies and comfort technologies to provide support for aging-in-place¹. One example are smart-homes. However, current systems are often inadequate in meeting user needs². In these cases the applications of the home automation system is blamed, although the actual cause of the mismatch between performance and user needs is often the middleware. This contribution focuses on middleware in relation to user needs, both of the end-user, as well as the engineer responsible for implementation and maintenance. **Method** A literature survey was performed concerning home automation projects (or smart-home projects) supporting aging-in-place (keywords: 'user needs', 'user requirements', 'aging-in-place', 'home automation', 'smart homes', 'intelligent home', 'mismatch', and their combinations). Web of knowledge, Science Direct and Google Scholar were used as search engines. From the project description retrieved, the actual middleware, the encountered problems and origin of these problems were noted, and the user needs that should be met, were determined. **Results & Discussion** A number of small projects, use old, existing and commercially available middleware technologies (e.g. X10 or Zigbee) because developing dedicated middleware is out of scope (as in the AT EASE project³). These systems miss flexible support for a wide range of applications, such as health (telemedicine), security (burglary alarm) or future applications (e.g. the wide range of iPhone applications and home robots). The Integration of these different applications required to successfully support aging-in-place⁴, is only possible when all applications from different vendors are supported. Many of these home-automation systems have vendor lock-ins, which have a negative influence on price and expendability as well as on integration. Middleware that is developed in R&D projects is often better equipped for integration, and open (no vendor lock-ins) through the use of, for instance, common internet protocols such as TCP/IP. However, hardly any middleware so far supports easy installation or adaptation (e.g. plug and play), or properly deals with malfunctions (e.g. self repair). Other commonly seen problems with middleware are limited data security, or too low bandwidth capacity (*Table 1*). Middleware design with well incorporated user needs is only attempted in the SOPRANO research project⁵, which is still running. A common cause of the mismatch between user needs and middleware is the absence of user needs in the development of the middleware. User needs are often only involved during development of applications. The development of the middleware is then based on requirements for the applications, instead of directly on user needs. This leads to the above described mismatch between performance and user needs. Currently available middleware systems for home automation often do not meet user needs associated with aging-in-place, because these needs are not incorporated in the design process of the middleware.

References

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Table 1: Some limitations of middleware reported in home automation projects

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- No integration with other technologies
 - Support small range applications
 - No easy adaptation and installation
 - Vendor lock-in
 - No proper dealing with malfunctions
 - Low security of data
 - Capacity problems (e.g. bandwidth)
 - High latency
 - No possibility for wearable devices
 - Expensive
 - Not prepared for future applications
 - No support for moving devices
 - No easy maintenance
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