Chapter 1
WISE: The Difference Between Smart and Smart Ass

> *For if every instrument could accomplish its own work, obeying or anticipating the will of others, like the statues of Daedalus, or the tripods of Hephaestus which, says the poet, of their own accord entered the assembly of God. If, in like manner, the shuttle would weave and the plectrum touch the lyre without a hand to guide them, chief workman would not want servants, nor masters slaves.*
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> **Aristotle**, *Politics* - from the translation by Benjamin Jowett [1]
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> *The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.*
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> **Mark Weiser**, *The Computer of the 21st century* [2]

About 2300 years lay between these two quotes. Although they stem from different eras, they both illustrate the wish of humans to enhance their quality of life by means of appropriate tools and technologies. Tools have supported and extended human capabilities and helped to overcome limitations since the beginning of mankind. This is observable in relicts of ancient times such as the *oldowan* [3]. In the year 2015, the endeavour to domesticate tools has still not come to an end. In recent decades a new category of technology, computing, has become ubiquitous and offers hitherto undreamed new possibilities to enhance each and every area of life, also in the home. Specifically the possibilities of *anticipation* emphasised by Aristotle are closer to become a reality than ever. However, the home constitutes a specific – and at the same time difficult – field in regard to tools and technology, because it has so many facets and serves multiple purposes and so requires the same of the tools available in it. As computing technology has started its triumphal march in other domains [4] it has still not optimally adapted to the home context. Many hurdles must be overcome before Weiser's vision of interwoven technology becomes reality. People spend about 70 % of their life time in their respective homes [5] and there is a great potential for the enhancement of life in the home with the support of technology that is capable of taking over responsibility, enables automation and anticipates user needs. But compared to other areas of life, the potential problems are just as great – as illustrated with the birthday story in the prologue. The inherent complexity and multi-dimensionality of the home requires

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a different perspective on the relationship between the environment, the tools and basic (computing) technologies, and their users; one that goes beyond the purely technocratic relationship which has been predominant in the smart home field for decades, both in industry and in research and development.

As an example, the slogan of the 1933 World's Fair – "*Science finds, industry applies and man conforms*" [6] reflects such a technocratic perspective. Despite the long time that has passed, parts of that philosophy can still be identified in today's smart technologies. In some form of technologies the specific circumstances of the home seem to be completely ignored. Neither the process of developing technologies nor their use is unidirectional, but reciprocal. This was expressed by John Culkin's saying *First we shape our tools and thereafter they shape us* [7]. Reciprocity is a characteristic not only in regard to tools but also in regard to dwelling, the relationship between humans and the home as whole, as Winston Churchill said in a speech that may have inspired Culkin: "*We shape our dwellings, and afterwards they shape us*".[1] Even simple tools, such as those from the Oldowan period have been shown to have such shaping power. This was illustrated by [8] who showed that over the course of about 1 million years, the central part of the human hand has evolved an extra bone to adapt to this tool. But also the tools themselves have changed and have been re-shaped by generations of users. Because of their long time periods, evolutionary developments are difficult to observe and comprehend. Compared to the tools from the Oldowan, computing technology has a short history. As a result, long term effects cannot yet be fully estimated. But when observing, for example, the respective and obvious impacts television, the internet or mobile devices had and still have on human behaviour [9], the long term impacts can be assumed to be high. However, a big disadvantage of today's tools based on computing technology is the limited number of ways in which they can be *shaped* by their users. We are missing the reciprocity described by Culkin, and, in the case of home technology, by Churchill.

The inherent complexity of the home one the one hand and the limitations of current technologies on the other are probably one reason why the concept of the smart home, has, since its introduction in the middle of the 1980s [10], been promised many times, but still has not become as popular as expected. The spread of technology that would deserve to be called *smart* in terms of being able of dealing with and appropriately adapting to such complex circumstances still lays far behind expectations on the private home sector, even though it was fairly successful in the industrial and public sectors [11, 12]. Today so many things are labelled *smart*. Smart TVs, smart phones, smart cars are only a few examples and the list could go on and on. It is therefore necessary to delimit the characteristics of smartness that will be addressed in this book.

The starting point of a large scale contention with smart technology in industry and academia was the coining of the term *smart home* in 1984 [10]. This was the first external sign of the endeavours to ring in a new age of technology [13].

[1] Speech, Oct. 28, 1944, House of Commons.

Since then many terms denoting smart technology have entered our language, such as *intelligent home*, *smart living*, *domotics*, *home of the future*, *networked home*, *internet of things*, or *robotics* [13–15]. The basic technologies can be applied in very different areas, for different purposes and in different building types. Because of the variety of applications and meanings of *smart* the research presented in this book is focused on the private home. This focus is necessary due to the inherent differences between private living environments and all of the environments and circumstances designated for other purposes (such as workspaces, public places, the outdoors, etc.). For example, private homes and workspaces are distinct when considering the factors influencing the adoption, acceptance and use of technology. The term *smart home* as used in this book is meant as an umbrella term synonymous to the terms enumerated above and focused on the context of private dwellings. The functional range of such smart technology is, for example, defined by [16, 17] who link smart technologies to the ability to integrate and network devices and to provide *intelligent functionality*. The most current forms of smart technologies are based on artificial intelligence [18, 19] and labelled *ambient intelligence* (AmI) *systems* [19].

One reason for the reluctance of humans to adopt such ambient technologies in their homes is probably the emphasized inherent but typically uni-directional *shaping power* of this type of technology and the degree to which it is interfering with daily life. In a typical home, Television, DVD players or household appliances are relatively wide-spread as stand-alone devices, although attempts to network these kinds of devices are increasing. Technology that assumes an integrative and connecting role and is, in the words of Weiser *interwoven*, is potentially more difficult to understand and to control. Given the long-term experiences that consumers have with relatively *harmless* technology, it is easy to understand related fears. An example of that kind of harmless technology, as provided by Norman [20], has achieved sad notoriety. He tells the story of an event in 1990 in which the former president of the United States, George Bush, Sr., articulated the following vision. "*By the time I leave office I want every single American to be able to set the clock on his VCR*". Twenty years later, Norman [20] provided a succinct comment on this vision – "*he failed*". The impact of a VCR on daily life is negligible, so long as we disregard simple annoyance. The potential consequences of smart technology that does not work in the expected way are observable in many examples and are no longer only relevant for techies but have reached public attention [21].

The situation described in the birthday story in the prologue includes a collection of problems that result from trying to use current technology in the home. Most of the devices in the example could be considered as kind of *smart*. They have a level of computational power that we could not have dreamed of a few years ago. They have capabilities and were designed to fulfil the needs required in the example – dealing with pictorial content. In fact, many devices with appropriate displays were present. Missing interface standards and issues of interoperability and integration meant that users could not *shape* functionality to their needs. As a result, the available *smartness* was useless. This is when technological features are apparently developed

from the limited viewpoint of technical capabilities and not from the perspective of user needs. To describe it with the words of [22], the devices can be considered ego-centric. Unfortunately, citizens of the so-called developed world are used to such technology-related problems, but it is understandable that their level of frustration about a questionable *smartness* increases.

It was the contrast between the ambitious industry and media forecasts on the one hand and the insights gained from real world observation on the other that inspired me to take up the smart home in a scientific manner. The followed approach is built upon Shneidermans [23] call for a paradigm shift in the domain of computing; exchanging the old computing (which was about what computers can do) for a new computing (which would be about what humans can do). In the same way, this book introduces a paradigm shift in home technology; away from the smart home centred on technological capabilities, and towards a WISE home that is about what humans need to enhance their living experience.

The paradigmatic change is necessary because in contrast to, for example, mobile devices, state-of-the-art home *smartness* obviously did not convince a reasonable percentage of people to adopt it into their daily lives. This is probably because the basic technology has proven to be less *smart* than "*smart ass*" [21]. As a result the attribute *smart* has developed negative connotations, specifically in the context of home technology. For example, *smart metering* has come to be associated with spying on people and abusing access to their personal data rather than to benefit from more efficient energy control. Such negative associations with the attribute *smart* do not only come to mind in regard to technology but also in regard to smart people. This assumption is based on an observation made by Sternberg [22], who could show that smart people are particularly susceptible to negative personality traits such as egocentrisum, delusion of omniscience, omnipotence and invulnerability. Some characteristics of smart homes have similarities to these traits. A variant of ego-centrism was illustrated by the birthday story. Another example is what Nielsen [24] at the end of the 1990s labelled as "*remote control anarchy*" representing a variant of ego-centrism conveyed by the manufactures of these devices. Some kind of omniscience-thinking is identifiable in a story depicted by [25] in which a smart home system switched off the lights (because it was the usual time for that) even though people were still sitting in the living-room. I witnessed a similar situation in a newly-built living lab in Germany. When the highly-sophisticated smart home system changed the lights without user request, one of the researchers responsible for the system turned to me and said: "Ich möchte hier nicht wohnen" (I would not want to live here). The message these kinds of smart home systems convey to the customers has frightening parallels to the *man conforms* philosophy. Humans would have to adapt their requirements to the capabilities of the technology, in most cases even brand specific ones. The basic operation mechanisms and interfaces are the only appropriate solution and competing products based on alternative usage patterns are doing wrong. As a result, any expectations or user habits that deviate from the features offered by that particular technology must also be wrong [5]. The solution is to broaden the perspective on the problem to one that goes beyond smartness.

1.1 Introducing the WISE Paradigm

The reason the new paradigm is labelled WISE and not, for example, *smart 2.0*, is to clearly convey a difference to the "*Man conforms*" [6] philosophy which is based on the self-conception that people would have to adapt to the features the technology offers. The result is depicted in Fig. 1.1 – humans imprisoned by the technology. Human computer interaction, which is one of the theoretical foundations of this book, proposes the evidently more appropriate approach of adapting technology to human capabilities. But as pointed out in the preface, HCI seems to have disappeared from the focus of attention. Introducing the new paradigm should contribute to re-gaining the attention again HCI deserves.

As an analogy to human development, where wisdom is considered a stage beyond intelligence, WISE aims at going beyond smart; overcoming the shortcomings of current smart technology as impetus for further research and development [26]. The WISE approach is built upon the characteristics of human wisdom, and as defined [22]:

> ...the application of intelligence, mediated by values, toward the achievement of a common good, through the balance among intrapersonal, interpersonal and extrapersonal interests, over the short and long terms, to achieve a balance among adaption to existing environments, shaping of existing environments and selection of new environments [22].

Wisdom does not have negative connotations in either its scientific or everyday use. This is what makes WISE different. In this sense the positive association with WISE is intended to be a message; a sign for potential users that a different approach to technology is possible. It might help to change the negative attitude to smart technology in general and to the smart home in particular. To be able to achieve this, WISE must be more than just another new label. The WISE home is designed as both a theoretical concept and a novel research approach.

The basic theoretical concept constitutes a combination of two dimensions, as illustrated by its acronym: **W**isdom-**I**nspired,**S**mart-**E**nhanced. The first dimension is devoted to a thorough consideration of human capabilities (wisdom-inspiration). The second, to enhanced smartness; building upon the capabilities of smart home technology with a focus on advanced possibilities of computing, such as Artificial

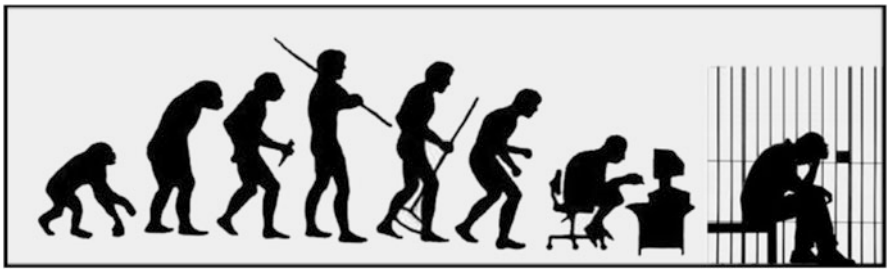

Fig. 1.1 The situation in a state-off-the-art smart home – the human is a prisoner of technology

Intelligence (AI). The goal is at once simple and difficult. The simple part of the equation is helping people to achieve *a good life*. This is closing the circle between Aristotelian philosophy ("*eudaimonia*"), the work of Weiser and current approaches in research which also focus on the *good life* aspect, such as positive psychology [27, 28]. The difficulty is illustrated by a quote from Weiser's influencial paper, to achieve this good life by ... *technologies that fit the human environment instead of forcing humans to enter theirs*.

WISE is an attempt to broaden the perspective on technology in the home in order to overcome the gaps in current home technology that have already been discussed. My background in psychology and my work in computer science (or more precisely HCI) provides an optimal starting point for this attempt; addressing the problem by following a human centric approach [29]. A progress in smart technology is not only relevant to the personal goal of achieving a good life, but also to what the European Union has labelled the *societal big challenges* [30, 31]. Challenges that are related to this book can be labelled as the triple E (Elderly, Energy, and, Effectuation). Technology in the private home will play significant role in meeting these challenges, but only once consumers are convinced of the benefits of adopting it into their day-to-day lives and enabled to appropriately use them.

- **Elderly** – Numerous publications and statistical estimations, cf. e.g. [32], show the rapid approach of major demographic changes. A shrinking group of working adults is confronted with a continually growing cohort of the elderly. This leads to bottlenecks in care and support due, for example, to a shortage of qualified personnel in nursing and healthcare. Smart home technology is often praised as a kind of panacea that might resolve the coming problems. Considering the example given in the birthday story in the prologue; who would want to be dependent on such technology for their health care, much less in a life or death situation?
- **Energy** – Scarce resources, specifically dwindling fossil fuel, are forcing large-scale changes in economy and politics. The increased participation of private households in energy issues is inevitable, because they are responsible for around 40 % of the energy consumption [18]. Different forms of participation are already going on and more can be anticipated. Smart metering can be seen as of some kind of participation, though a rather involuntary and passive one. Metering alone would not lead to the expected effect. Active forms of participation would be necessary addressing the intrinsic motivation of consumers and include conscious and voluntary behavioural changes in order to sustainably reduce energy consumption. These can be, for example, reducing standby energy or increasing the consciousness of device use. To achieve this, the possibility of *shaping* technology according to the consumers' needs has to be made available by appropriate means of observation, intervention and correction.
- **Effectuation** – It is necessary to reduce costs specifically in times of economic crisis. Companies and public authorities are therefore constantly searching for possibilities of cost reduction. One solution is the replacement of expensive offline-services with slim and cheap online self-service. As a result, people

are increasingly confronted with digital interfaces to governmental, medical or financial services. People who are not able to deal with these changes are in the danger of becoming victims of the digital gap. The need for self-services and the need for self-maintaining and administering computing technology will also increase in other domains. In this sense [33] predict an age of systems that are *easy to develop* following the age of *easy to use*. But, as shown in the birthday story, even the preceding age has not fully been reached yet. The active contribution to computing technology in the home (similar to the Web 2.0) will therefore require adequate means of interaction as well as a re-consideration of basic human requirements and needs. As Davidoff [25] formulated it, the focus has to be clear: "*People do not want to control devices, they want to have better control of their lives.*"

The home constitutes a central point in life and plays an important role on a personal and societal level. People spend a significant amount of time in their homes [5, 16], with the goal of leading a good life; a goal that is both simple and difficult to achieve. Everything that contradicts this overall goal in the long term will probably not succeed. People will only accept technology if it is useable; if it has understandable practical benefits or supports attitudes and values either on the individual or on the societal level. After decades of home technology that is about half smart, it is now time to fill the smart home with a new spirit. In this sense, the old smartness, which is often not observable, accessible or comprehensible has become outdated and a new approach needs to be undertaken.

However, it has to be clear that the goal of WISE is not to make technology artificially WISE. A similar attempt with intelligence in the past was only partly successful. WISE aims at enhancing technology in a way that it is capable of behaving in a WISE way such that it cooperates with its human users. In contrast to a smart(ass) home, which overexerts or overrules, the WISE home acts and reacts like a thoughtful granny observing her grandchildren; giving them support when they need it, but letting them experiment and explore in order to learn how to interact with and control the world around them. The primacy of WISE is that technology adapts to the humans and the prevalent environmental conditions, and not the other way around. This book is both a summary of previous research work, and an initial step towards the new paradigm. It aims for the identification of a possible avenue for further development of private living environments.

In Part I of this book the current chapter and Chaps. 2 and 3 provide an overview of motivation and the theoretical backgrounds upon which the WISE approach has been built. Chapter 2 is devoted to the basic theoretical concepts, with HCI as the central foundation and those human aspects that are considered as specifically relevant in the interaction with smart homes. The notion of the home, its meaning as a central place in life and its facets is addressed in Chap. 3.

Part II of the book starts with a historical discourse of technology in the home in Chap. 4, from ancient times until the present era of the smart home and points out those aspects which are most relevant in regard to the WISE home. Chapter 5 presents a basic framework of WISE derived from the theoretical considerations of

Part I. The framework allows for a smooth integration of two principle forms of interaction: explicit interaction (related to HCI) and implicit interaction (related to AI, AmI). Chapter 6 is devoted to the methodological approach to be followed to empirically investigate the WISE concept, with an emphasis on fieldwork. The lead concept of the approach is user experience, but other concepts will also be presented.

The final part, Part III, starts with the presentation of examples for an empirical proof of the WISE concept in Chap. 7 corresponding to the three stages of developments, presented in Chap. 5. The final chapter, Chap. 8 provides an estimation of how the home of the future may look like, and why it should be WISE.

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