

# Ethical Assessment in the Design of Ambient Assisted Living

Veikko Ikonen<sup>1</sup> and Eija Kaasinen<sup>1</sup>

<sup>1</sup> VTT Technical Research Centre of Finland, P.O.Box 1300, 33101 Tampere, Finland

**Abstract.** This paper tackles on ethical issues that are relevant when designing new technological service systems for the assisted living. In this paper we present our preliminary ethical guidelines that are built on six ethical principles that are selected based on the ethical assessment of MINAmI (Micro-Nano integrated platform for transverse Ambient Intelligence applications), FP 6 Eu – project, scenarios. The aim of ethical assessment is to conclude concrete and clear ethical guidelines that could be used as check lists in MINAmI platform design, demonstrator design and further in general in designing applications onto the MINAmI platform. We assume that this kind of checklist is also useful for other Ambient Assisted Living type of developmental work.

**Keywords:** Ambient Assisted Living, Ambient Intelligence, Ethical Guidelines, Privacy, Scenarios, Human-Centred Design

## 1 Introduction

This paper gives guidance on ethical issues that should be taken into account when designing applications and services that utilise MINAmI (Micro-Nano integrated platform for transverse Ambient Intelligence applications) platform for mobile-centric Ambient Intelligence. The guidelines also cover issues related to implementing the MINAmI platform itself. The guidelines are divided to impact on design solutions: what kinds of solutions are ethically acceptable and impact on design process: how to design ethically acceptable solutions. Impact of ethical principles on design solutions is analysed on two levels: 1) general technical features of mobile AmI and impact of ethical principles on them and 2) impact of ethical principles on application field specific features of mobile AmI. In the latter the focus is on MINAmI-specific application fields: health care, assistive technology, housing and everyday. During different phases of the technology design process, required ethical considerations are different. The perspectives of different stakeholders should also be taken into account. By means of a holistic perspective we can consider the challenges, threats and opportunities in advance when designing new technologies for our future everyday environments.

Ethical concerns regarding the vision and products of the project as well as the user evaluations carried out within the project are dealt with the two-fold ethical management structure of MINAmI. The project's internal Ethical Committee reviews

the user evaluation activities carried out within MINAmI with regard to ethical concerns. The Ethical Committee prepares and maintains an ethical guideline document for the user evaluations and ethical problems that may come up during the project work. The ethical concerns which arise and their solutions are reported annually. An Ethical Advisory Board includes external experts of different fields of ethics. The Ethical Advisory Board identifies and evaluates broader ethical implications related to the project vision, goal, and products. The Board publishes the “Ethical guidelines for mobile-centred Ambient Intelligence”.

Ethical guidelines are built on six ethical principles that are selected based on the ethical assessment of MINAmI scenarios:

*Privacy:* an individual shall be able to control access to hi(s)her personal information and to protect hi(s)her own space

*Autonomy:* an individual has the right to decide how and to what purposes (s)he is using technology.

*Integrity and dignity:* individuals shall be respected and technical solutions shall not violate their dignity as human beings

*Reliability:* Technical solutions shall be sufficiently reliable for the purposes that they are being used for. Technology shall not threaten user’s physical or mental health.

*E-inclusion:* Services should be accessible to all user groups despite of their physical or mental deficiencies.

*Role of technology in the society:* The society shall make use of the technology so that it increases the quality of life and does not cause harm to anyone.

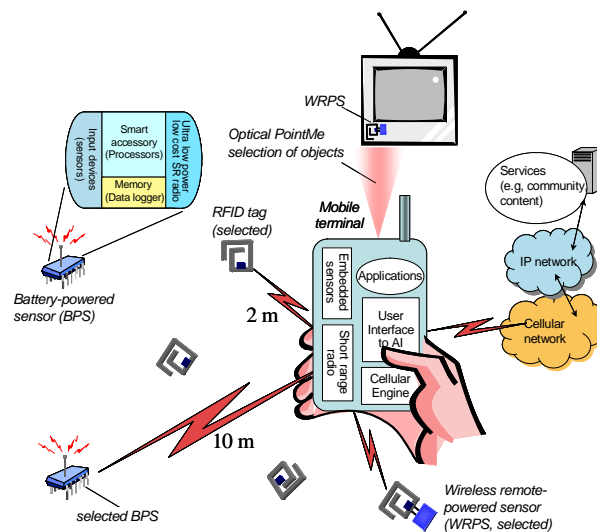
## 2 MINAmI vision

The MINAmI (Micro-Nano integrated platform for transverse Ambient Intelligence applications) vision is based on a mobile-centric approach to ambient intelligence. With the mobile device, the user can communicate with the surrounding environment by wirelessly reading close tags and sensors embedded onto everyday objects. In addition, the phone enables wireless connection to the internet. As the communication can be tied to a specific place, object, and time, this approach enables context-related information and services. The vision is based on the previous EU – project, MIMOSA (Microsystem platform for MOBILE Services & Applications) architecture (Fig. 1), extended with new MINAmI technologies: mass storage radio frequency (RF) tag and event sensitive RF tag.[1, 2] . MINAmI applies a human-centred design approach in the infrastructures, such as the platform, tags and common usage patterns. This design approach makes possible to affect basic design decisions that may have effects on user acceptance and ethical issues regarding all the applications that will use the MINAmI Ambient Intelligence infrastructure [3].

The six main MINAmI scenarios describe the application demonstrators under development in detail. Two of the scenarios, *Memory tag* and *Virtual keyboard*, are everyday scenarios, and the rest four scenarios, *Smart pillbox*, *Smart home*, *Sleep*

*plaster*, and *Hearing device*, fall in the categories of health care, assistive technology and homecare [1, 2].

- With the *Smart pillbox*, dosage can be monitored based on recognizing when the pillbox is opened. Suspected dosage hazards are reported to health care personnel via the mobile phone.
- At *smart home*, ambient cameras monitor moving objects at home and alarm the inhabitant when possible intruder is recognised. The cameras also recognise suspected health hazards and alarm health care personnel accordingly.
- The *sleep plaster* monitors electroencephalogram (EEG) overnight. In the morning, the user transfers the measurements to his mobile phone and sends them further to health care personnel.
- The *virtual keyboard* is projected on any flat surface, facilitating the use of full size keyboard almost anywhere.
- *Memory tag* embedded on a newspaper ad contains mass memory from where the user can upload media content: a movie trailer onto her mobile phone.
- *Hearing device* embedded on a mobile phone utilises directional microphones with which the user can select the sound sources to be amplified and to be faded out.



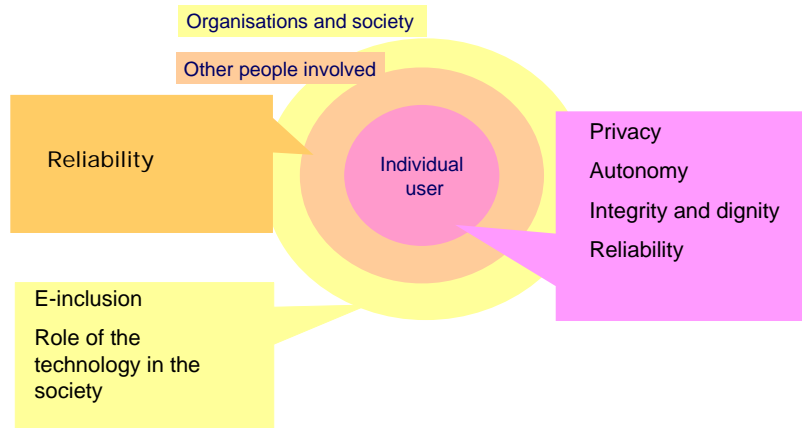
**Fig. 1.** MIMOSA architecture

### **3 Ethical principles in MINAmI**

MINAmI application scenarios were evaluated by the Ethical Advisory Board that consists of external experts. They classified their findings according to six ethical principles: privacy, autonomy, integrity and dignity, reliability, e-inclusion as well as the role of technology in the society. We have used this classification also in the guidelines presented as they seem to cover key ethical issues related to mobile-centric AmI solutions and they reflect the common understanding of identified general moral values.

The law, ethics and religion are closely entwined with each other and are affecting together to the rules of conduct (moral principles and rules)[3]. Usually these approaches are working together but sometimes there are also conflicts between different approaches. Key legal issues of Ambient Intelligence environments are: privacy, data protection, intellectual property rights (IPR), particularly copyright (access to content; content adaptation) and contract law. The European legal system provides reasonable protection e.g. to the user privacy, but it should be also ensured that the legal system will not prevent useful services. Privacy is currently well dealt with on the level of information privacy but AmI solutions bring in the needs for spatial and bodily privacy as well. It seems that directives should be made more technology neutral than they are today.

Ethical assessment is required throughout the product life cycle. A remarkable challenge is how to get the attention of the designers and increase the awareness of ethical issues with different stakeholders throughout the design process. Possible negative consequences or threats noticed in any of the design phases should be brought out clearly. Hiding negative effects could also be damaging in business sense in the long run. A holistic view to the design is needed (Fig. 2.): extending the view of users in the design from individual users to other people involved has already taken into account in many cases. Still we need to look these questions also on higher levels (organisations, society) to be able to assure that the best possible design decisions are chosen in the case of conflicts between different stakeholders. It is also important to understand the forthcoming nature of the future designs: it is assumed that in the future Ambient Intelligence environments people are not just mere objects for the design but active participants and subjects in all phases of design.



**Fig. 2.** MINAmI ethical principles on different levels of the society

## 4 Ethical guidelines for mobile-centric ambient intelligence: example assessment of two principles

In the following we propose two examples of ethical guidelines for mobile-centric ambient intelligence: reliability and e-inclusion. Examples are in the form of check lists for application designers and designers of the MINAmI platform.

### 4.1. Reliability

Technical solutions shall be sufficiently reliable for the purposes that they are being used for (fig. 3). Technology shall not threat user's physical or mental health.



**Fig. 3.** Reliability of service system is a critical matter

### Application design

- The measurement accuracy is sufficient for the purpose that it is used
- The algorithms with which measurements are combined and analysed are sufficient
- User conception of the reliability is in line with the actual reliability

### Platform design

- The platform is promoted as an application platform only for applications where the reliability requirements can be fulfilled, regarding both measurement accuracy and measurement frequency
  - Need to recharge batteries is indicated in time
  - Users should have ways to ensure the trustworthiness of tags for viruses and other hostile elements

## 4.2. E-inclusion

Services should be accessible to all user groups despite of their physical or mental deficiencies (Fig. 4).



**Fig. 4.** Everyone should be able to use the services

### Application design

- No user group is ignored without strong reasoning

### Platform design

- Alternative modalities are supported in user interaction

### Societal practices

- Can all citizens be provided with equal possibilities to anticipate health hazards?
- Can assistive technologies provide people with above normal abilities. To what extent is that acceptable?
- Does AmI technology used for independent living actually isolate elderly and disabled people in the society?

## 5 Future Work

The aim of ethical assessment is to conclude concrete and clear ethical guidelines that could be used as check lists in MINAmI platform design, demonstrator design and further in general in designing applications onto the MINAmI platform. We believe that this kind of checklist is useful for other Ambient Assisted Living type of developmental work too. This aim is quite ambitious as ethical principles tend to be easily acceptable but not so easy to concretise. It is clear that in this phase we can only introduce tentative guidelines, and a lot of further work is needed to produce concrete and extensive guidelines. The guidelines cannot cover all aspects of individual applications and services. That is why ethical issues need to be studied in the design both by user interviews and evaluations and by assessments carried out by experts of ethical issues. We will continue refining the guidelines together with our Ethical Advisory Board parallel to the ongoing development work in our project as well as user evaluation activities.

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