Project FoSIBLE
Fostering Social Interactions for a Better Life of the Elderly

D3.1 – Report on concepts for the new devices

Responsible

Fraunhofer IMS

Mauser Care

Deliverable

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Abstract

The objectives of this work package are to develop and build prototypes of the interfacing devices, that can be used to proof the new interaction concepts. These prototypes will be a combination of sensors and actuators with furniture. As a result, the goal of this work package is to develop a set of “smart” furniture that accompany the TV based applications by natural and intuitive user input and output options. This deliverable is the first from work package 3 and the scope is to form the basis for following developments of this work package.

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1. Introduction

1.1 Background and Related Tasks

Task 3.1: (Responsible: Mauser Care, Collaboration: FhG IMS) Development of concepts for innovative devices/furniture, with sensors for input and output. This includes creating concepts on how to integrate these sensor data from the environment into the social media center applications. Currently plans target at sitting furniture, beds as well as wardrobes and sideboards. Note that in order to come up with prototypes within a short time frame, only sensors that are available on the market will be considered. Currently, application of the following sensor types is considered: proximity sensors (capacitive measurement), RFID-based sensors, infrared based sensors. Note that this list is not exhaustive.

Task 3.2: (Responsible: Mauser Care, Collaboration: FhG IMS) Development of proof of concepts (prototype based) on the basis of the developed concepts for testing validity and acceptance by end users. Development will be done in two phases. During the first phase, mock-ups will be created that provide the test users with look and feel of the final devices. These mock-ups will be used to gather first user feedback. In the next phase, a set of full functional prototypes will be created that will then used to gain detailed and exhaustive end user feedback.

Task 3.3: (Responsible: Mauser Care, Collaboration: FhG IMS) Integration of hardware and software components (platform). These prototypes will make use of standard communication solutions (wireless) to connect the sensors with the application platform.

Task 3.4: (Responsible: Mauser Care, Collaboration FhG IMS) Combine the devices for input and output and the software applications in order to make them usable for remote interaction.

Task 3.5: (Responsible: FhG IMS, Collaboration Mauser Care) Development of hardware interfaces for different locative scenarios (e.g. different rooms). This task also addresses using of the shelf domotic sensors (e.g., motion detectors) in order to gather valuable information about the current state of the habitant.

Task 3.6: (Responsible: AIT, Collaboration Mauser Care) Integration of a vision-based sensor technology into a furniture object to explore the posture and facial expression of the users.

1.2 Scope of This Deliverable

The objectives of this work package are to develop and build prototypes of the interfacing devices, that can be used to proof the new interaction concepts. These prototypes will be a combination of sensors and actuators with furniture. As a result, the goal of this work package is to develop a set of “smart” furniture that accompany the TV based applications by natural and intuitive user input and output options. This deliverable is the first from work

package 3 and the scope is to form the basis for following developments of this work package.

2. Input and Output Opportunities

The sensors and actuators, which can be installed in the domestic environment, provide different opportunities for their analysis and utilization. To achieve a better understanding we classify the following three categories.

2.1 Collecting Contextual Information

The collection of context information affords a possibility to record immediate measurement reading from the environment. They can directly be read off the sensors, so that further analyses are not necessary. Because of these sensors it is possible to draw more conclusions, which afterwards can be interpreted as awareness information.

On one hand context information is data, initiated by the user himself, like the weight after weighing or the heart rate after taking the pulse and on the other hand sensor information of the environment. Sensor information can be received from movement-, door- and window sensors, light barriers, reed switches and temperature- and air quality sensors. A light switch can be considered as a sensor as well and thus provides information. For example it provides the location of the user, as he has to stand next to the switch to use it. Due to this information you can determine the location of a user in a single-person household. The determination of position is related to the context information, even if it demands further analyses of the sensor information. Due to data protection regulations only the FoSIBLE-Application can exclusively determine the position of the occupant. Other members of the Social Community Platform do not receive this data, because it can only be used for control.

2.2 Collection Personal Information

The personal data of a user offers us information simply referring to the user himself, for example his sensation or his presence. Information about the user`s sensation can be received when he is bored and seeking the company of friends, when he is excited or when he is happy about something. Not all of the before mentioned characteristics can only be defined by sensors, without telling the system the actual sensation manually, but some of them can be identified by means of the context information.

The mere presence is easily accessible from sensors such as motion or occupancy sensors. However, it provides a reliable notification of whether the person is available for community. This information should be adjustable later, so that the user can decide whether the mere presence is enough to qualify as available. Another requirement could also be that the users are already in interaction with the community in order to maintain the status "available". With this information it is possible for the other participants to contact the user, while fully respecting its terms.

Other personal information may also be helpful to the user. For example, the personal weight and pulse can help the user to learn something about themselves and share this with someone. For example the actual weight could be available by itself as an absolute value and for the friends as a target value like "lose 3 kg". This makes it possible for the users, to share his goals with their friends.

A group of participants can thus share a common goal and try to achieve it through mutual assistance and motivation. Furthermore it can determine with different context information an "activity index" which indicates whether the user was in the last time very active or not. Using this value, the user should be tempted to do more. The decrease of the index can be counteracted by a course visit, playing a game or sporting activities. These are recorded by the system and afterwards provide the opportunity to give comments and share the event information among each other. Through the sharing of the events, other participants of the social community become aware, so that the user can visit at the next time the course with a friend. This scenario can be applied to games in the same way.

2.3 Control interfaces

Different input possibilities for interaction with the social community should be given to the user. These may be buttons with fixed functions, as well as context-dependent functions. In the following chapter possible combinations are described, as soon as controls are integrated into the user environment.

2.3.1 Integration of the controls in the user environment

The integration of control options in the user's environment is versatile. Because we restrict the project to the home environment of the user, furniture as everyday items is a promising possibility for this purpose. The user has in his immediate surroundings furniture, which are used by him in different ways. Furthermore, the inclusion of TV furniture is quite appropriate, because the output of the Community Social FoSIBLE is mainly located on the TV. This suggests the integration of the sofa or chair and coffee table, as they are in the interaction with the television in the immediate vicinity of the user.

For this purpose recessed buttons are added into the armrests of the chair (Figure 1a) which reflect the traditional functions of a remote control. These are embedded using proximity switches in the surface and any function can be assigned to them.

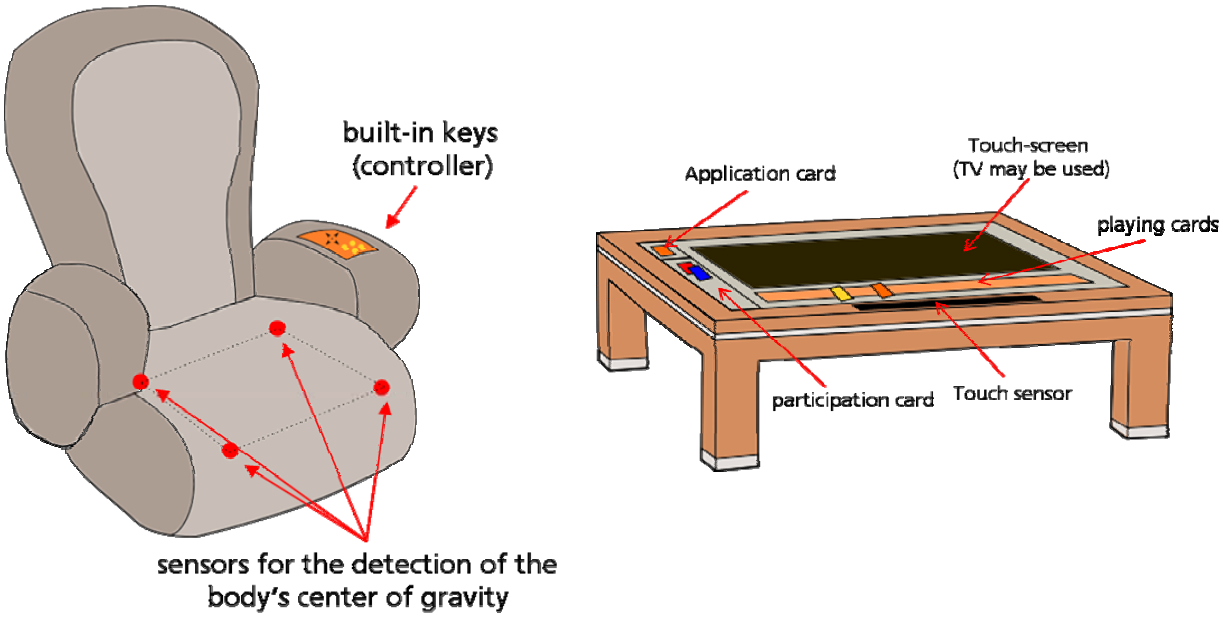

Figure 1: Concept with arm chair (a) and coffee table (b)

Furthermore, it is possible to attach pressure sensors into the seat which an active interaction with the game allow even while sitting. Because of the different seating positions the pressure sensors can determine a balance point, which can be used as input value. If at this point a feedback for the user is needed, a vibration can also be possible as haptic output. This must be clarified, in the course of the project. The integration of the coffee table (Figure 1b) allows installing additional controls, as this provides an additional area. Here it is possible to trigger specific events using proximity switches. They can be identified by icons on the surface or by a fixed color, which map to a function on the screen. A function is executed on contact with a switch. Furthermore, we realized in the middle of the surface a gesture input area that responds to different touch gestures. At first a simulator (Figure 2) for this purpose is used. It is necessary to clarify whether this is used in a prototype in the future running of the project.

Figure 2: Simulator for 2D gesture recognition

Furthermore, a RFID reader, hidden in the furniture, can also induce functions defined over RFID cards. This allows drawing on a wide range of functions, but without extra space for each function on the table surface. The disadvantage of RFID cards is that the application will quickly become confusing and therefore the use is moderate to operate.

Based on the knowledge acquired in the project, that users usually are reluctant to change the familiar furniture, the above concepts have been revised. Thus a new mobile element has been designed for the integration of controls, which serves as an extension to existing furniture. The newly worked out element is to be regarded as a mobile unit that can be placed to the required position and used there (Figure 3). This has the advantage that the user can use the FoSIBLE functions not only in the chair, but at several places. The user can carry the piece of furniture and thus has the interaction elements in the immediate vicinity.

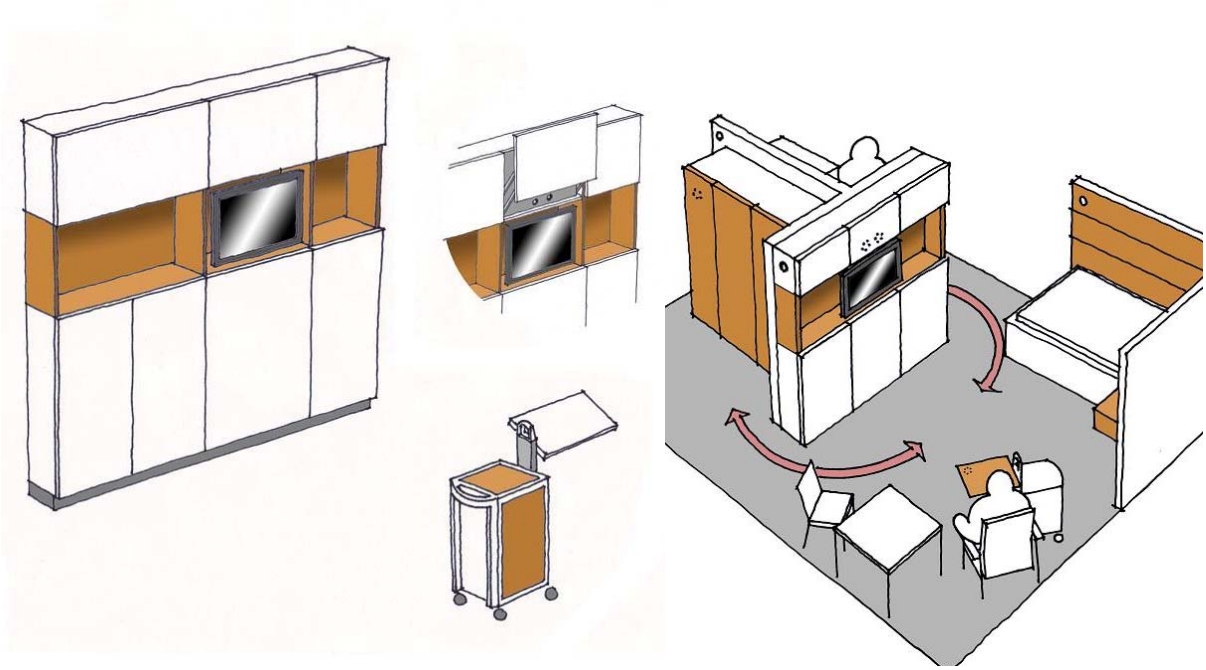

Figure 3: TV environment with mobile unit

Another way of controlling is of course the use of wall switches. These are known to the user and therefore have a certain familiarity. However, since all operating functions could also be used at this point, devices were used which are compatible with the home automation bus "enOcean" (Figure 4). This allows the switch be marked with ordinary functions like turning on a light as well as starting and interacting with programs in the FoSIBLE environment.

Sources: www.detech-shop.de www.enocean-alliance.org

Figure 4: Examples of enOcean components

In addition to the sensors which are intended for direct user interaction with the surrounding, additional sensors in the environment of the user are available which allow capturing the action of the user. Thereof in the cabinets and drawers in the apartment sensors are available, called reed contacts, which can detect if a cabinet door or a drawer

are opened or closed. Based on these values it is possible to infer the physical activity of the user, as well as the currently executed activity. The scope of the data and their analysis need to be measured during the project.

2.3.2 Scenarios for Using Control Technology

The controls listed in Chapter 2.3 provide a variety of combination options. This chapter will set this in the context of the FoSIBLE environment and defines possible scenarios. How the control elements will ultimately be used, depends on the future used menus and games. But these are developed during the project, so the scenarios listed here are according to fit. However, it is attention to conventions defined by the project partners in structuring the menus and games, so a match is expected in the developed applications.

Starting Applications

To start applications, the user can navigate in the menu using the embedded arrow buttons in the furniture, where he can find the icon for the desired application and initiate it with the confirmation button. This is done using the proximity sensor in the furniture. Because a not too deep hierarchy navigation helps the user in the overview, this can equally be used for navigation through different levels.

For applications which are used frequently, it is useful to map these to additional buttons on the table surface because a constant search for the user in the menu does not offer the intended ergonomics. For applications which are executed relatively often, but are not very important, this can be done with the help of RFID cards, so that during the usage of the RFID cards, the application is started.

Selection of Participants

The selection of participants to interact is possible in different ways. One method is to search the participants from a menu followed by selection of the participant. After complete consumption of all participants, starting the desired joint action is possible. The disadvantage of this alternative is that participants must be searched separately and added. This takes some time to complete. Another possibility is the selection of participants via RFID cards. This is possible if the user has the requested subscriber cards, which he exchanged for example in the previous visit with the real person. These cards can be placed on the RFID area and thus add the participant. The advantage of this method is a convenient and fast selection of the participants. The disadvantage however is that it is possible that one participant has not all cards of the other participants and therefore the cards must be exchanged previously in the real world. Especially for a new friend, which lives additionally in a distant place, this is not always possible. Therefore, a combination of both methods should be respected.

Deliberate (Direct) Control of a Application

The simplest way to navigate within a running application or controlling something is possible through the built-buttons in the furniture. This will enable us usual game pad functions of other systems to the control elements of the furniture reflect, so that at the same time, the control concept could be adopted. Moreover, it is also possible to navigate through the menu and control structure because this is based mainly to the arrow buttons and an enter button.

A further possibility to carry out an operation is by the gesture recognition panel in the middle of the table. Through the panel different types of 2D gestures are recognizable. At this point only basic gestures are planned, because an accumulation of complicated gestures unnecessarily complicates Human-Computer Interaction. Therefore, these gestures can be interpreted in the same manner as the embedded buttons, but it has to be clarified later in the project, which one of the two forms of control receives a greater acceptance by the user. This will be carried out in future evaluations in the project.

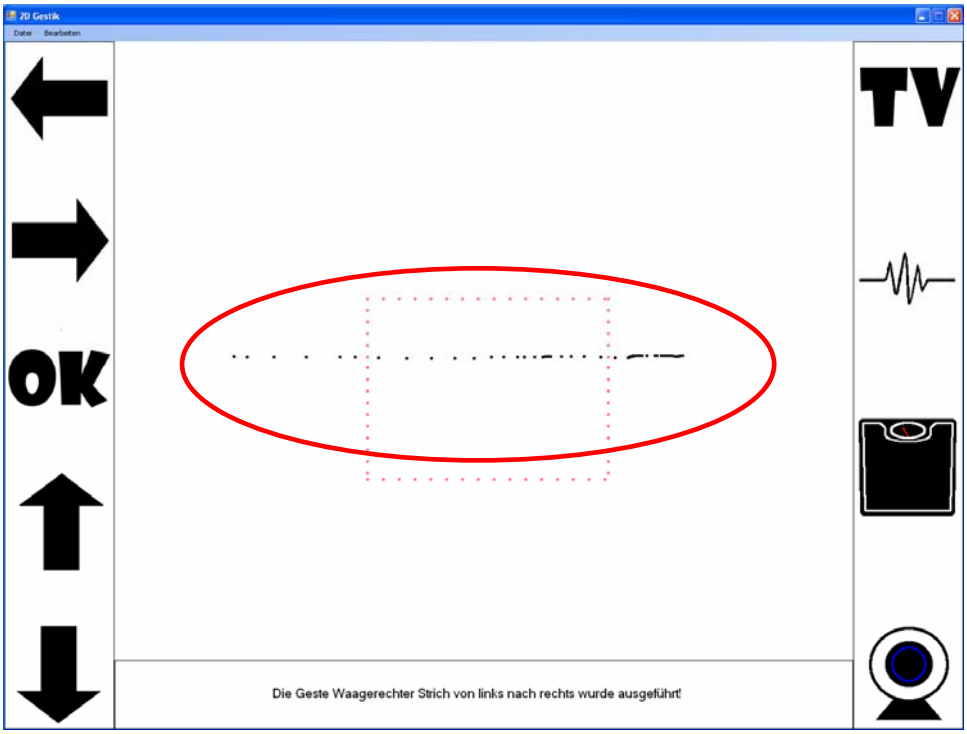

Figure 5: example gesture (left to right associated the command "right")

In addition to the buttons and gestures, it is possible to control the application using the attached pressure sensors on the furniture. This allows a control through the user's movements, so that the interaction includes the whole body of the user. This type of operation is especially suitable for games. By the motion the user is more involved in the game and can combine achieved successes in the game with own sporting achievements.

Thus, for example, playing can be a part of the fitness program, which is not boring for the user and still helps him with the health. In order to incite the user to repeatedly use the exercise, the game may be provided with points that afterwards can be shared with friends in the social community. This also provides another conversation topic that can be discussed in a common group.

Further possibilities include the furniture into direct control of applications is possible via the built-in cabinets and drawers sensors. This allows immediate detection of openings and closings. An example use of these sensors could be a memory game. Thus, a series of drawers can be set to be sequentially opened and closed by the user. Associated this with objects that are known in these drawers, a search can be performed for the objects. Because users are familiar in their home environment very well, this can result in easy success. At the same time it can be customized for example by increasing the difficulty of looking for objects and thou even more fun can be obtained playing the game. These kind of games can help people to train and maintain their cognitive abilities

For controlling the application of course, a combination of the above operating concepts is possible. During the testing of the usability these aspects should be examined separately and in combination in the current project.

Automatic (Indirect) Control

An analysis of the collected data at run time enables the usage of the collected data as an additional input option or as further information for the system. Through the collected data, as described in Chapter 2.2, these properties can be identified as a new user. Using this information, recommendations can be generated. A determination of the activity of the user, as described in Chapter 2.2, can for example be used to generate game suggestions. An active user could get for example some relaxation exercises as recommendation. An inactive user sport exercises. This results in an equitable distribution of the exercises.

The information acquired through the environment can serve as additional information for gaming and community interaction. For example, the pulse can be displayed in a game, to measure the effort of the user and can also be included into the game with. For example, the user needs to try not to exceed one individually determined heart rate within the game, so that the user learns how to reassure themselves after an exercise.

Furthermore, the collected data can be determined, as described in Chapter 2.2, to achieve an "activity index". This may indicate how active the person was in the last time. This index can be displayed in the community so that the user can see a direct connection between his actions in real life and in the virtual world. The index can also be used as a value in a point system, allowing the user to collect points in order to show his activity in the community. His points can be increased by the "activity Index", as well as by participating in events. So the user will have an incentive to register and comment to attended events.

3. Sensor Integration Framework – Mauser Runtime

3.1 Overview and Architecture

For the use and further processing of the ambient information described in Chapter 2, they must be covered by appropriate sensors. Furthermore the information has to be prepared for the further processing. Subsequently the FoSIBLE-specific interpretation of sensor events occurs on a higher application layer.

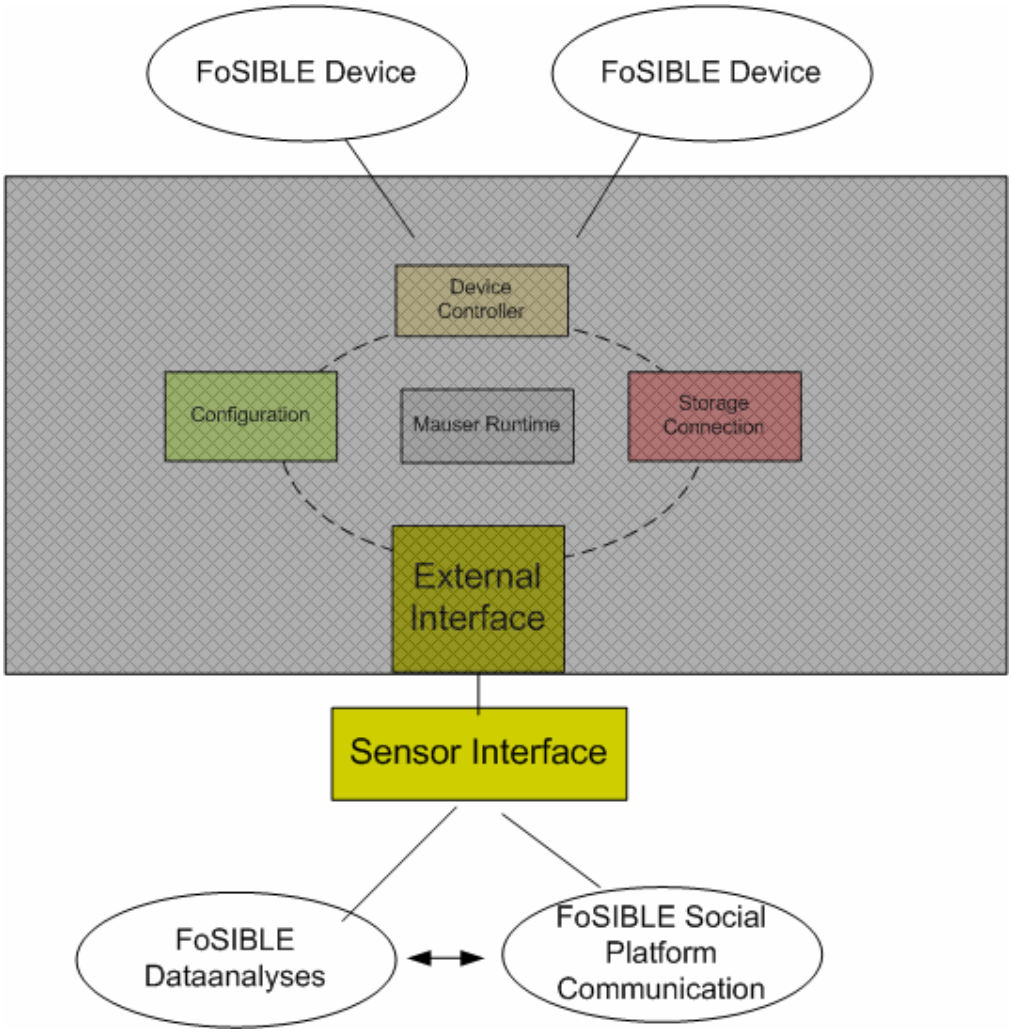

Figure 6: Overview Mauser Runtime

Developed for this purpose the Mauser Runtime (Figure 6) allows the integration of multiple sensors of the building automation bus "enOcean". These afford the sensors to receive and provide content for other applications. The device access used in the Mauser Runtime is, based on the changeability of the requirements, abstract, so that the currently used components can be replaced in the future, without any adverse effects taking place at a

higher application layer. This has the advantage that the individual components are easily maintainable and interchangeable.

The Mauser Runtime consists of associated device controllers that are responsible for processing the device data. The devices are kept abstract, so that a replacement of a device does not disrupt the system itself. The collected data can be buffered in a database, so that by switching off the Mauser Runtime the content will not be lost and it can be updated after rebooting again. For connecting external applications the Mauser Runtime includes an interface that can be addressed via TCP. Detailed information about the interface takes place in chapter 3.3. Furthermore the Mauser Runtime has a communication interface for the FoSIBLE Social Platform, so that a data exchange can be done. Please see chapter 3.4.

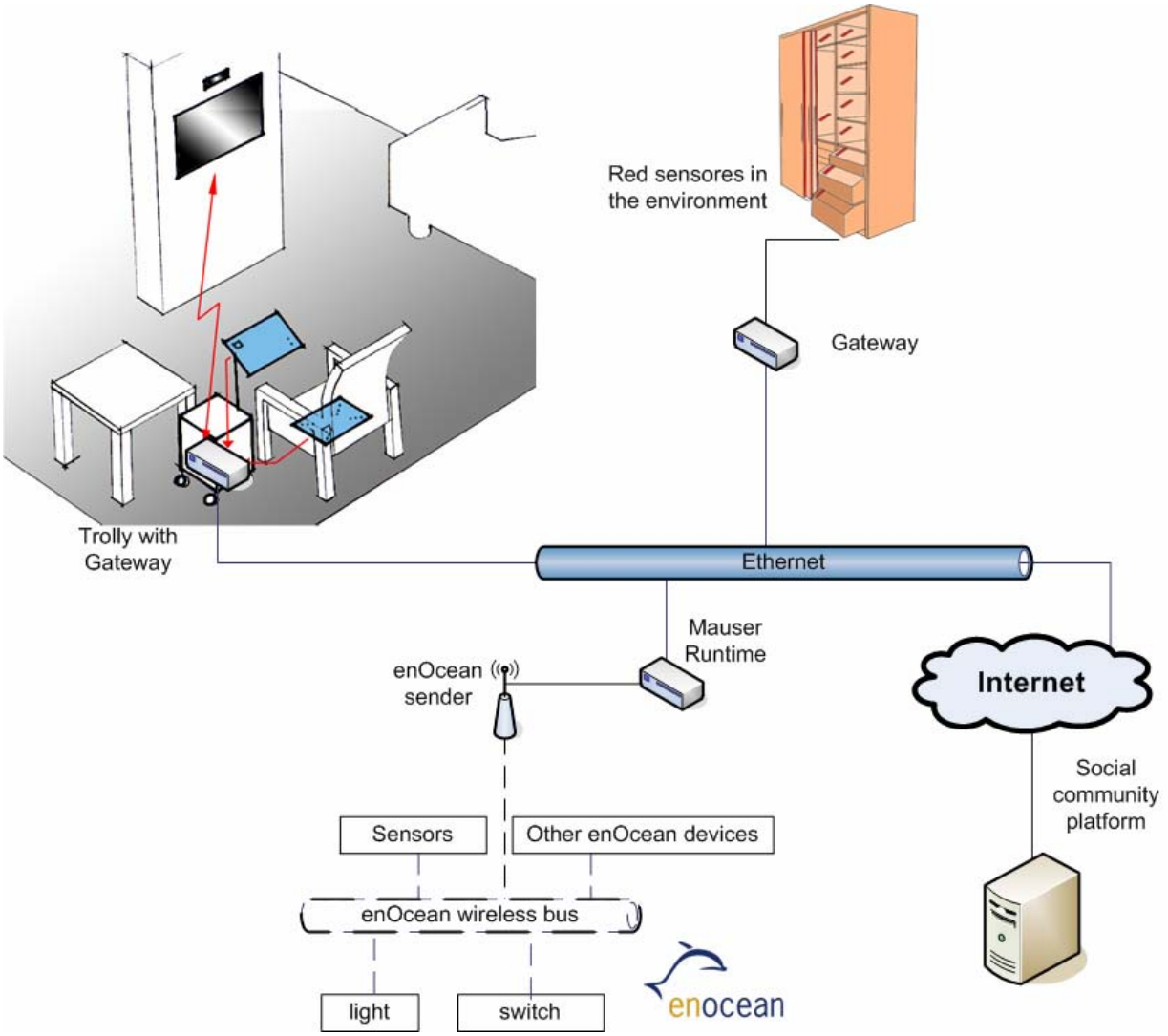

Figure 7: Communication between the components

As illustrated in Figure 7 the individual components communicate with each other by the Mauser Runtime. Mauser Runtime processes the incoming signals into virtual events and afterwards they can be interpreted by applications. Via LAN all components can exchange data, whereat the device signals will be readout by the Mauser Runtime by radio or cable and then converted for sending them by IP, so that they can be sent via LAN too.

3.2 FoSIBLE Sensor Interface

The FoSIBLE sensor interface allows external applications to communicate with the Mauser Runtime by the TCP protocol. Therefore a port on the Runtime monitors incoming inquiries to start an initialization in which external applications can register to the Mauser Runtime. After successful registration various methods for external applications are available. Furthermore relevant events for the external application will be forwarded, so they can react. The data exchange occurs by so-called JSON objects, because they do not need large amounts of data and are easy to parse. Detailed guidance for communication will be developed together with partners in the prototype development.

3.3 FoSIBLE Social Platform Interface

The FoSIBLE Social Platform is a web-based server solution, which is simply accessible by internet connection. For this reason the Mauser Runtime receives a HTTP-protocol-based interface, which affords a communication with the Social Platform. This allows the Social Platform to receive different status messages by the Mauser Runtime, as well as to leave simple messages at the user-specific presentation-site of the Social Platform. In this way it is possible to create several messages at furniture and send them directly to the Platform. This message can be for example an advice to the user's actual condition, which can be pictured by icons. But this method of implementation belongs to the applications, which are based on the Mauser Runtime and therefore they will not be explained at this point.

4. References

Christian Müller-Tomfelde: Tabletops – Horzontal Interactive Displays, Springer, London 2010, ISBN 978-1-84996-112-7

Sunny Consolvo, Jerey Towle: Evaluating an ambient display for the home, ACM, New York 2005, ISBN 1-595-93002-7

Markus Dahm: Grundlagen der Mensch-Computer-Interaktion, Pearson Studium, Munich 2006, ISBN 3-827-37175-9

Homepage from JavaScript Object Notation, http://www.json.org/

Sibylle Meyer, Eva Schulze, Petra Müller: Das intelligente Haus - selbstständige Lebensführung im Alter, Campus Verlag, Frankfurt/New York 1997, ISBN 3-593-35723-2

Jakob Nielsen, Rolf Molich: Heuristic Evaluation of User Interfaces, ACM, New York 1990, ISBN 0-201-50932-6

Bernd Schorb, Anja Hartung, Wolfgang Reimann: Medien und höheres Lebensalter - Theorie Forschung Praxis, VS Verlag, Wiesbaden 2009, ISBN 978-3-531-16218-8

Ulrike Streich: Altersgruppenspezifische Probleme beim Usability Design von Webdiensten, Magisterarbeit an der Universität zu Köln, Köln 2005