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Farming Cell – An ISOagriNET compliant network for pig housing systems

Today in animal husbandry, an integrated controlling and automated documentation of the production process is limited. Reasons are that devices from different manufacturers are not able to communicate with each other. There are also no commercial products available that are able to combine data from devices and use it in an overall management system [1]. The aim of the standard ISOagriNET [2] which was published in 2007 is to standardize the communication between technical equipment in animal husbandry. The implemented system, called Farming Cell, at the research station for fattening pigs „Unterer Lindenhof“ uses this standard for data transfer. This system can easily be expanded by integrating additional sensors or meters and uses low-cost hardware and open source software.

Keywords
ISOagriNET, IT FoodTrace, Precision Livestock Farming

Abstract
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Software and electronic systems used in pig production are working autonomically. Communication between such systems in terms of data exchange is unusual. Therefore a system integrating all components in the stable has a huge potential [1]. In order to enhance networks in animal housing systems the international standard ISOagriNET was published in 2007. This standard defines processes for data transmission between components and data formats. Consequently all devices in the network providing ISOagriNET are able to exchange data [3]. Within the research project „Information and Data Collection in Livestock Systems“ an ISOagriNET farm network, called Farming Cell, has been developed, implemented and tested. The development process included the design of useful data exchange processes, upgrading present devices using self developed hard- and/or software and equipping the barn with additional sensors in order to measure relevant process data.

Hardware architecture

The research barn is divided into two compartments and one shared anteroom. Both compartments have two pens with a capacity of 30 pigs each. The climate and feeding control and the scale with RFID reader are located in the anteroom. In addition to these devices, many sensors measuring e.g. temperature, humidity, brightness, NH_3, CO_2, differential pressure as well as heat, water and power consumption. Linking up these components to the local area network by using the Ethernet as networking technology was done in different ways and is shown schematically in **figure 2**. The majority of components are linked via a self developed gateway (Hohenheimer Messwerterfassung – HME) to the network. Other units, e.g. some sensors, are connected to the network through Ethernetboxes

Fig. 1

Mobile management application by using a Psion with RFID Reader as example

(Ethernetbox from better networks: http://www.messpc.de/ethernetbox.php). Feeding and climate control are exceptions and linked up in other ways. The first one offers only a serial port (RS422). Therefore it was linked to the network with a serial to Ethernet adapter. The second one, the climate control, offered a serial port too. In order to link up this device to the local area network an ISOagriNET adapter was built and installed by the manufacturer.

Software architecture

Based on the described hardware infrastructure, self developed software services are operating. On the one hand these services transform the individual protocols or signals into ADIS/ADED . On the other hand they act as UDP Multicast gateway or as TCP server publishing and/or receiving data. **Figure 2** shows how the services which are running at the lower software layer are embedded in the overall software architecture.

The software services at the lower software layer can handle the individual protocol of the component they are nested in. Nesting is done virtually; physically these services are placed on a separate computer. There are two kinds of services. The first type is a simple gateway, only publishing ADIS/ADED messages to a multicast group (UDP Multicast Gateway). The second type is a connection-oriented server service accepting requests and sending back data (TCP Server).

Additional software services, communicating with the described services mentioned above. These TCP Clients and a UDP Multicast Receiver are located in the middle software layer. They are responsible for data collection and storage. Both have write access to the database to store received data. The database is the central element of the Farming Cell. Besides the data from all devices and sensors there are additional data allocated by the management system. Furthermore the installed sensors are recorded precisely. Their coordinates inside or outside the barn, measured with an accuracy of one Centimetre, are stored in the database. With these data it is possible to model spatiotemporal relations (e.g. measurement points and measurement periods).

Additional access to the database is provided by two software components (Web application and ReST Service) located in the upper software layer. Both components have individual read access; limited write access is reserved to the web application, which is the Farming Cells graphical user interface (GUI). The GUI offers for authorized users to manage the fattening process and to look at the measured data. Compared to commercial products, the developed web application offers the following advantages:

- Management, process control and process documentation in one application
- Web based, therefore platform independent
- Mobile management using mobile devices (e.g. Psion, PDA)
- No redundant keeping of data, therefore no synchronisation necessary.

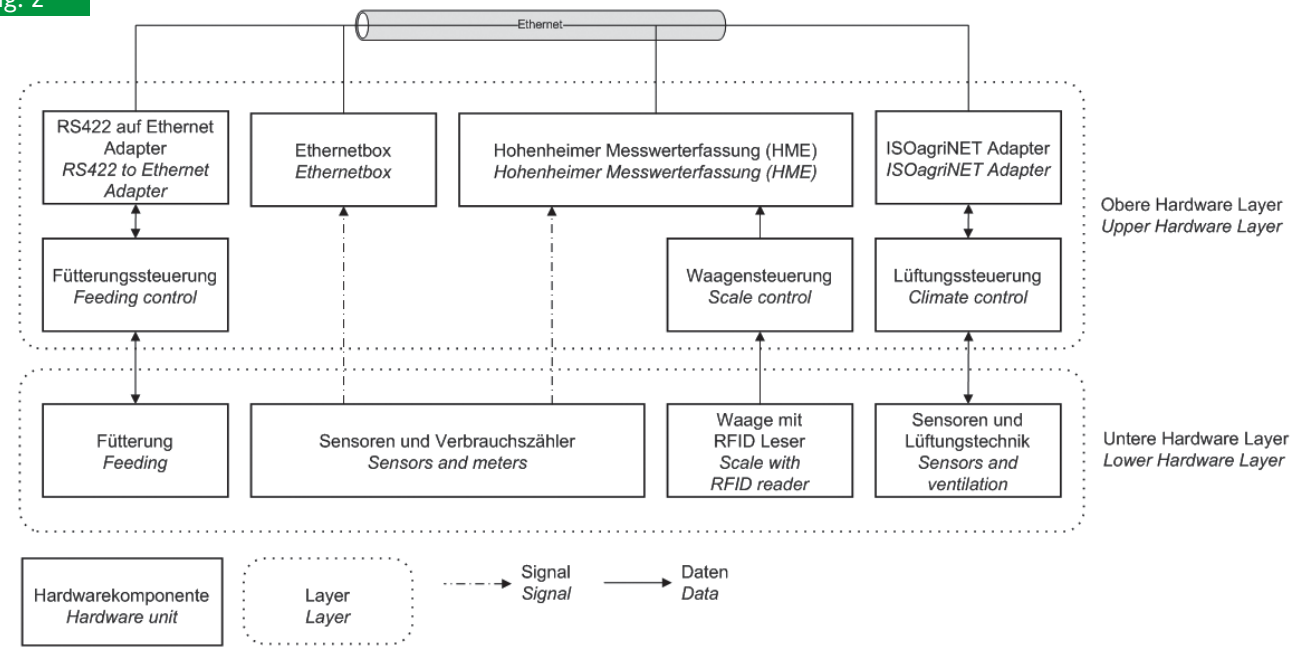
The possibility to manage the fattening process is integrated in the web application.

Tasks like moving in, moving around, moving out or treating animals can be recorded either for an individual animal or a group of animals.

The management can be done using a standard computer or a mobile device like a Psion or PDA. The pigs can easily be identified by their individual RFID ear tags **(figure 1)**.

A requirement for mobile management is the presence of a wireless local area network (WLAN) at the point of work. Of course it is

Fig. 2



Hardware architecture

possible to enter data afterwards at the computer.

Contrary to management tasks, data visualization and data export are only available using a computer. Measured values, device data and management data can be viewed and exported using the web application. Furthermore it provides functions for documentation purposes as for example printing of medicine lists, showing weighing data and others. Generated reports for a user defined period of time are based on all available data. In addition the raw data can be exported to files of different types (e.g. PDF, XLS and CSV).

Conclusion and outlook

Connecting different sensors and devices to an overall system is complex and requires expert knowledge in fields of hard- and software. Especially varying or missing hardware interfaces as well as unsuitable software interfaces regarding ISOagriNET result in high development effort.

As a research tool, the Farming Cell offers capabilities to work on scientific questions in fields of e.g. animal behaviour, air quality and climate.

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Glossary

ADIS (Agrocultural Data Interchange Syntax) and ADED (Agrocultural Data Exchange Dictionary) are ISO Standards. They define the syntax and the content valid for ISOagriNET messages.

ReST (Representational State Transfer) is a style of software architecture for distributed hypermedia systems such as the World Wide Web. It is based on the protocols HTTP, HTTPS and Uniform Resource Identifier (URI) [4].

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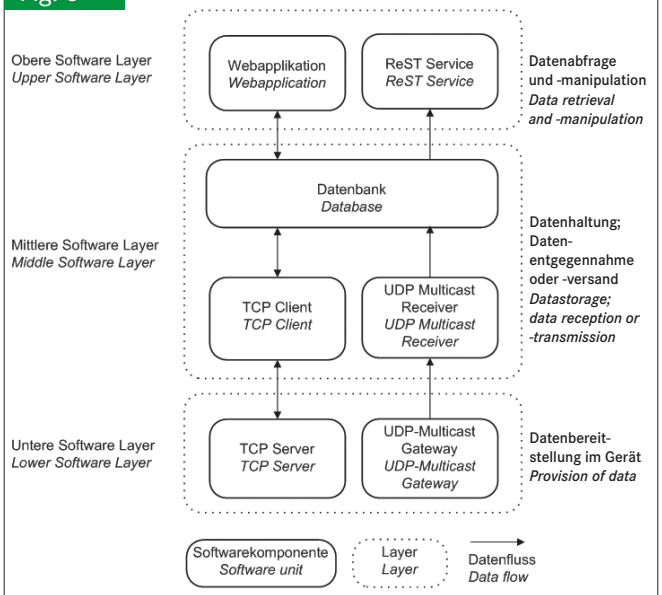
Fig. 3



Software architecture