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Remote Service Systems for Agricultural Machinery

Option for Diagnosis and Recommendations for Organisation

Nearly all manufacturers of agricultural machinery offer systems for remote data transmission between machines and a service control centre. In this context, the extent to which remote diagnosis is possible, in addition to the pure transmission of process data, must be analysed. The objectives of remote service systems are not only the acceleration and a quality improvement of the service processes but also cost savings. The results of the final report of the joint research project "Determining the Basics of Remote Services for Agricultural Machinery" and recommendations for itsorganisation are presented here.

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Keywords

Remote service, remote diagnosis, remote data transmission

Main objectives of remote service systems are the remote diagnosis of machine break-downs as well as a conditioned-based maintenance to avoid downtime.

Basically there are two kinds of developments which have to be distinguished in order to examine the possibilities of remote diagnosis and monitoring. In short-term the methods for a rapid trouble shooting and the remote monitoring of process parameters by human experts will be more important. Computers are primarily calculating assistance and support monitoring functions routinely.

In long-term real expert systems based on neural networks and fuzzy control systems will adopt the monitoring of the machine parameters widely autonomously.

But the machine data is just one part of the data belonging to a remote service data base. *Figure 1* shows which information has to be aggregated in a data base.

Monitoring-Tools

The visualisation of machine and process data can be realised in a quick and simple way by using small programs.

For this purpose a java based tool was designed at the ILF. The program has access to the SQL-data base where the machine data is stored. The program is composed of an administrator-part which defines the measured values, the projects, and the connection to the data base and a client-part which runs the actual application. The first step is the visualisation and the threshold survey of individual values, which can be displayed in different ways (status lamp, rev meter, load bar, pure display of the value). The thresholds can be entered directly as fixed values or they are calculated from other parameters, which makes relative limits possible; e.g. the comparison of different hydrostatic propulsion systems. Further on the existing values can be combined to get new parameters. In addition there is a possibility to integrate characteristic lines in a simple form. These can be used for an analysis of the engine or for the determination of the efficiency factors of hydraulic components. Furthermore general information of the machine and its history can be imported into the data base. For the transmission of the data it is still expedient to use the Short Message Service (SMS) [3].

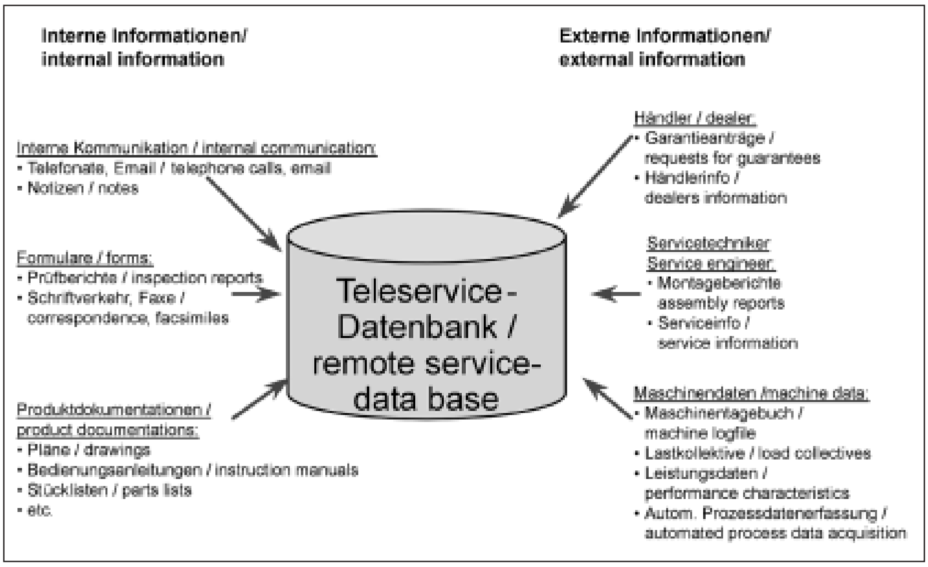

Fig. 1: Information sources for a remote service system data base [2]

Online Diagnosis

Another possibility for a service support is a point-to-point connection between the machine and the remote service unit in a service control centre. On the side of the machine a modem is linked to the CAN-Bus. The modem transmits the data which is shown on the remote service unit. A filter takes care that only the relevant data is transmitted. *Fig. 2* shows the modules of the online diagnosis system of the Grimme Inc.

The ECUs are in each case the master of the communication of the terminals. If the terminal on the service side, which is similar to the machines terminal, is started, it will identify the remote service mode. There is a special software for this mode on every terminal. The connection is build using a dial-up menu. After the build-up of the communication, the most important machine data (like year of manufacture and machine type) is transferred. Subsequently the remote service terminal boots up again. It operates in machine mode now which means working like a mirror with a direct connection to the machine.

All information which are recallable on the machine terminal are now also available in the service control centre. This way sensors and actuators are diagnosable and parameters are adjustable. For safety reasons, the operation of machine functions is locked in this status. [4]

Neuro Fuzzy Classification

In future the automatic classification of machine data by neuro-fuzzy-methods will probably be an assistance.

At this point, approaches of neural networks and fuzzy logic are combined.

The first are composed by a net of neurons. These neurons represent small processor units, which convert input-signals into output-signals by simple operations.

Neural networks are of particular interest, if the classical physical models can not be build or if the complexity is very high. [5, 6]

The second part is formed by fuzzy systems, which allow a diffuse characterisation of the values.

Within the scope of the project this method was examined with the program NefClass for PC. Based on measured data [7, 8] learning data was generated, which was used for training a neuro-fuzzy network. The rules for the classification of the data sets were created by the program itself. Subsequently the network was tested by modified data sets. The classification showed a good reliability, which was increased by supplementing rules manually.

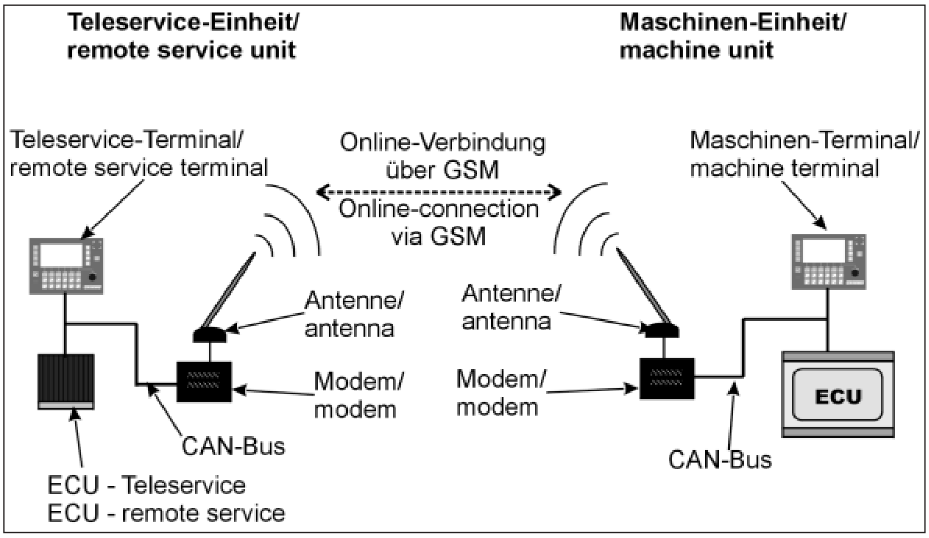

Fig. 2: System components of online diagnosis [4]

However, the localisation of errors and the diagnosis by these methods are very complex as there is a need for a very capacious representative data base which is filled with as much different operating states as possible [9].

Recommendations

Within the scope of this joint research project recommendations for the design and the development of a remote service systems for agricultural machinery were acquired. [10]

These recommendations are split into the divisions strategy, organisation, staff and engineering.

Concerning the technical development several statements are compiled. One of them is the requirement of a modular design principle for rapid adapting to changed environmental conditions. The number of development and application platforms should as low as feasible. Incremental implementation has to be preferred to the purchase of complete-solutions. For economic reasons, internet technologies should be used as often as practicable; furthermore attempts for a standardisation within the branch might be supported. Complementary sensors provide more information about the machine, but they have to be subject to a cost benefit analysis. The statistical processing of machine spanning data has to occur very advisedly because of the high change in environmental parameters.

Developing a strategy the potential of revenue has to be calculated at an early stage by the analysis of proposals, customers, and processes. During the implementation one has to anticipate longer times and a high investment volume. Other added values (fleet management, precision farming) might be integrated into the co-operation by strategic partnerships.

Within the company a willingness for the structuring, visualisation and probably the reorganisation of the processes is necessary. The value of the system is not the used hardware, but rather the requirement-adapted software and a practicable entire structure.

A suitable language for the problem description makes it easier to work with the system as well as the use of easy manageable front-ends.

But the long-term road to success can only be build up with consistent continuation of the remote service philosophy within the company and the willingness to optimise the business processes.

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