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Robotics in German agriculture

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Abstract

Robotics has long been a dream in agriculture. Based on the developments currently available on the European market, the status in agriculture and livestock farming will be presented. It is evident that robots for milking, feeding and cleaning are widely used in cattle farming. In arable farming, they are currently mostly used for plant protection and there are initial development approaches that also take over soil cultivation and sowing. A major problem, especially in arable farming, is still the legal situation regarding liability for damage caused by autonomous driving in the field. This is slowing down development here.

Keywords: smart farming, legal framework, labour shortage

1. Introduction

Autonomous work performance via technological systems has been a great desire in agriculture for a long time. Early on, ideas or utopias were developed to transfer hard or strenuous physical work to mechanical systems. This often goes into the area of heavy soil cultivation via ploughing machines or machines for grain harvesting. The fantasies of the first combine harvesters in Europe that this approach could be carried through to the bread roll at the end of the machine also go into this area. The desire for robots in agriculture is therefore already old.

There have been several technical approaches in the last 100 years. In livestock farming, for example, these include feed cranes for basic feed in cattle farming in the 1920s with cam track-controlled mechanics or barn systems in the 1970s with autonomous carts that transport the dairy cows back and forth between the feeding, lying and milking areas. In arable farming, this often involved controlling the machine in the field. In the 1950s, this was controlled by rope systems that triggered special steering actions via knots in the rope. An electric-hydraulic approach was implemented by the ploughing robot (Agri-Robot) from Eicher in 1964. In this system, ploughing in a field including headland management was possible without an operator. Steering systems from the 1970s that were controlled via furrow sensors also go in this direction.

With the availability of GNSS, a new system for position determination was established from the mid-1990s onwards: At the same time, further developments in sensor technology in the areas of ultrasound, laser, radar and image analysis enabled new possibilities for environment analysis. The issues of robotics could thus be tackled again with new possibilities.

2. Materials and Methods

Using the example of current market developments in Germany and Europe, the state of robotics in arable farming and livestock husbandry will be presented. The problems of implementation with regard to society and the legal system will also be discussed.

3. Results and Discussion

3.1. Crop production

Crop production offers many opportunities for robotics. Following the availability of highly accurate GNSS, parallel driving systems spread relatively quickly in European agriculture in the 2000s. From there, it was only a small step to the development of autonomous systems. In 2011, AGCO Fendt introduced the Guide Connect "Electronic Drawbar" system. This involves a second unmanned tractor following a tractor with a driver. The problem with the subsequent market launch was not the technology, but the legal framework. It was not clear who would assume liability for possible damage to third parties. This massively slowed down the development of robots in arable farming. Development then sought another path. Towards the end of the 2010s, small robots for crop protection and precision seeding were presented. These developments were so small that they did not pose a major threat and were able to prepare the market first. Currently, there are several suppliers for chemical and mechanical crop protection and sowing based on robots on the market. In the meantime, there are also concepts for robots in the performance class of standard tractors (Figure 1) that can be coupled with the usual implements in the 3m to 6m working width range.

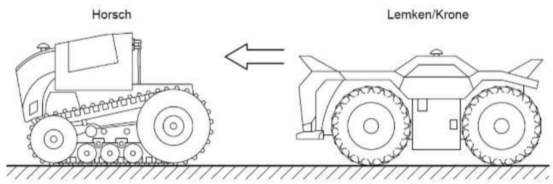

Figure 1: Field robot

3.2. Livestock farming

In livestock farming, robots began to establish themselves in the dairy sector in the 1990s with milking robots (AMS). Here, the milking process is carried out independently by a robot. In the classification of robotics, this type of robot, which interacts directly with a living being, is called a service robot.

Since the 2000s, this technology has become more and more widespread and is now the dominant technology on the market, especially in small and medium-sized dairy farms. For some years now, there have also been functioning systems for large farms over 500 dairy cows.

After taking over the main task of milking, the robots quickly found their way into the areas of feeding and cleaning. The robots partly navigate through the herd of cows. The standard tasks in the cow barn can thus currently be taken over by robots.

This also has an impact on the farmer, who now has to redefine his role between cow and robot. He now has to actively seek a relationship with the cow, as normally only the robot has contact with the cow.

In poultry and pig barns, the development of robotic systems took longer. The reasons for this are the already extensive automation in this area, the lower economic possibilities and also the technical challenges due to more animals per area.

Currently, there are initial studies on cleaning robots for breeding sows in the pig sector. In the fattening poultry sector, the first litter robots are on the market that recognise the need for litter and add it as required (Figure 2). During this step, animal behaviour and health are also documented.

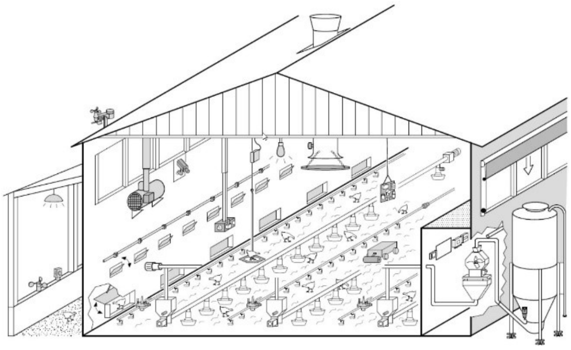

Figure 2: Automated poultry house

In the case of horses, there are corresponding systems that recognise the faeces in the exercise area and send a robot to clean it.

In closed stables, the development of robots has been quicker to catch on because there is possibly less discussion about the legal situation here, as stables are closed and there is therefore less dangerous contact with third parties. This is also confirmed by the current discussion on feed mixers, which travel between the barn and the silo and thus have contact with the outside.

3.3. Legal framework

The implementation of robots, especially in arable farming, has long been blocked by the lack of a legal framework. The EN ISO 18497 standard has created a framework for this. The principles described in the standard can be summarised in six core requirements: Environment Detection of persons or obstacles, Fixing of the machine in the working area, Environment Check before commissioning, In case of hazard detection warning signal and safe condition, Possibility of intervention via operating personnel and monitoring via remote control. On this basis, a risk assessment must be carried out by the manufacturer.

This already provides a concept for dealing with robots. What is even more difficult is the general attitude of society towards robots. In Germany, the dangers and risks are always discussed first and then the opportunities and possibilities are not discussed. A further development of society is necessary here.

4. Conclusions

It turns out that there are many opportunities for robots in agriculture in Europe. There is also a lot of interest from farmers. Especially in dairy farming, there are already many robots. In crop production they are now coming more and more. One area that still needs to be discussed is the social acceptance of robots.

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