RESEARCH REGARDING THE USE OF AGRICULTURAL EQUIPMENT FLEET MONITORING

Vlad Nicolae ARSENOAIA[1], Roxana Nicoleta RAȚU[1], Ionuț VELEȘCU[1], Andrei ISTRATE[1], Ioan ȚENU[1]

e-mail: vnarsenoaia@uaiasi.ro

Abstract

Agriculture is an important branch of any national economy with the most diverse functions: biological, the main source of economic activity and the use of labor force, an ecological factor for the protection of the environment and the fight against desertification in many areas of the Earth, a way of life, a technical and cultural tradition and, last but not least, agriculture is a civilization. In Romania, agriculture continues to hold a particularly important status, although it is going through the most profound restructuring process of ownership and exploitation system. It has remained one of the priority branches of material production, all the more so since the economic and social progress of the contemporary world is in close correlation with the level of achievements in agriculture and cannot be conceived without the strong development of this branch of production.

Key words: fleet, monitoring, agricultural equipment

Precision agriculture refers only to the use of advanced technologies for carrying out agricultural works. That is why it cannot characterize the whole formed by an independent agricultural system. Precision agriculture is a subsystem especially of the sustainable and ecological agriculture systems, but also for the intensive agriculture system (Matthias N., 2020).

Thus, thanks to the use of information and technology in crop management, it is possible to achieve:

- monitoring of works on each plot;
- guidance or self-guidance;
- precision.

Precision agriculture encompasses a set of technologies that combine sensors, information systems, improved machinery and management to improve production. In order to ensure the food supply for the future, adequate quantities and quality of agricultural products are needed. In addition, the ability to track food products from production through processing, storage and retail sales offers the opportunity to respond to changing market conditions, to provides elements for a correct and healthy nutrition.

Precision agriculture, or information-based management of agricultural production systems, emerged as a way to apply the right treatment to the right place at the right time (Cazacu D., 2021).

The rise of technologies like global satellite navigation systems, geographic information systems, and microcomputers, together with an increase in the degree of soil variation, are the major elements that support precision agriculture.

Simulation models, decision support systems (DSS), geographic information systems (GIS), GPS, remote sensing, production maps, and precisely applied chemical products are all parts of precision agriculture (Marcal D., 2020).

Precision agriculture seeks to achieve the following goals by maximizing the use of soil, water, and chemical inputs (fertilizers and pesticides) on a specific local scale: obtaining large and consistent in time and space productions of high quality; optimizing economic profits; fully implementing environmental protection; enhancing the sustainability of agricultural systems; and lowering the production cost per unit of product.

MATERIAL AND METHOD

The rapid development of modern agriculture has imposed greater requirements for monitoring the operation of agricultural machinery and for intelligent management.

A comprehensive telematics solution involves fuel monitoring, operating parameters monitoring, GPS tracking and uptime tracking of tractors, harvesters and other agricultural vehicles,

[1] Iasi University of Life Sciences, Romania

which are widely used in agro-industrial complexes and agricultural enterprises.

Agricultural machinery fuel monitoring provides opportunities to detect excessive fuel consumption, normalize fuel consumption quotas for each operation, monitor fuel tank filling and emptying volumes and prevent fuel theft, which occurs due to adopted excessive consumption quotas or violation of operating procedures.

Monitoring the operating parameters of tractors and harvesters allows the fleet manager to monitor compliance with operating procedures, check the operation of auxiliary and attached equipment, supervise the operation modes of the machines (engine speed, instantaneous fuel consumption, coolant temperature, pressure the oil).

Machine uptime tracking helps adjust time quotas for specific jobs, accurately records actual engine operating hours, also allows input of employee compensation system based on actual hours worked.

GPS tracking of tractors and harvesters provides information on the location and route of vehicles, the direction and route of travel and allows the detection of misuse of machinery and misuse for private purposes.

The effects of implementing the agricultural machinery monitoring system (*figure 1*) are: reduced fuel and lubricant costs; optimization of fuel consumption (detection of excessive consumption); prevention of diesel theft (fuel tank siphoning and theft from the engine return pipe, insufficient filling of fuel in a tank); reduction of maintenance costs; remote diagnosis of faults; prevention of failures; prediction of the maintenance date taking into account the actual operating conditions of the equipment; increasing fleet performance; reduction of excessive stop times; prevention of improper use; strengthening work discipline.

Depending on a fleet's current situation, the telematics system can reduce the fleet's total fuel expenses by up to 30% and lower repair and maintenance costs by up to 20%.

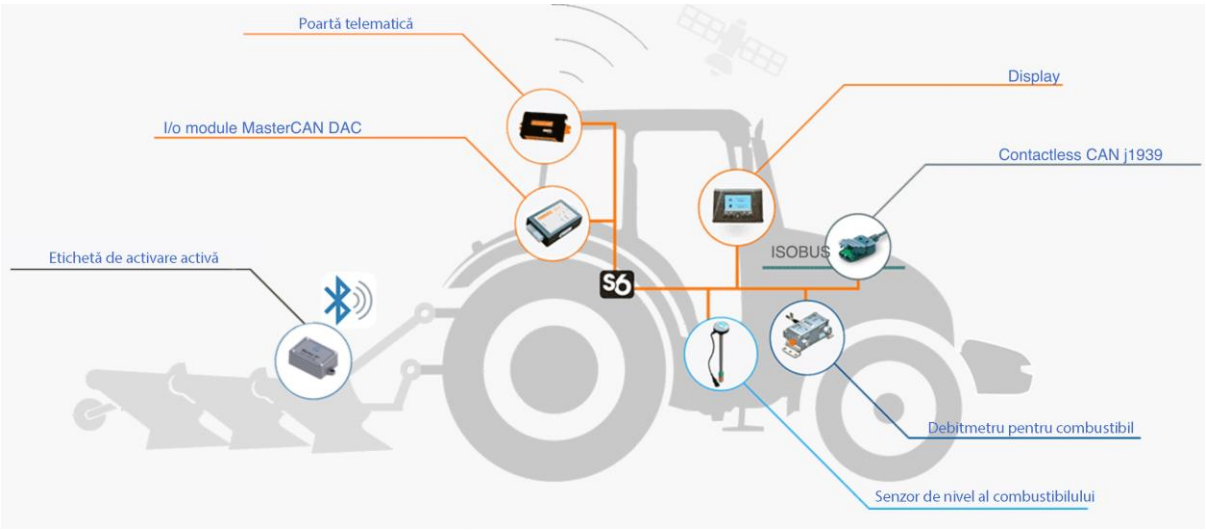

Figure 1 **Fleet tracking telematic system**

Video surveillance systems offer a multitude of advantages over traditional security measures, providing opportunities to save money and even increase the efficiency of the systems you currently operate.

With the help of video monitoring it is possible to: access images in real time (livestreaming); whenever the tractor is turned on; automatically record images when pre-set events are triggered; view recorded images, from a set moment.

Benefits of the video monitoring service are: cameras can be installed inside or outside the cabin, to control how the machine works; quality and safety control of work by installing a monitor in the cabin, thus eliminating blind spots; monitoring the perimeter around the machine.

Devices that are currently designated as IoT have been deployed in agriculture for many years already. There are mainly proprietary solutions where the devices are integrated into agricultural machines and therefore their use is closely related to the machine manufacturer. A major development in this area is expected in the near future, thanks to numerous projects focusing on open solutions that would eliminate the compatibility problems of proprietary devices.

The use of IoT leads to large scale or big data that provides valuable information.

For this reason, many studies have attempted to transform such data into useful information and knowledge. One developed an online microclimate monitoring and control system for greenhouses.

The system was supported by a WSN to collect and analyze plant-related sensory data to provide climate, fertilization, irrigation and pest

control. Someone used data derived from WSNs to discover knowledge through data mining.

This study focused on leaf spot disease, assessing relationships between crop, climate, environment and disease, based on wireless sensors and field-level surveillance.

A classifier was trained to predict the disease. One proposed a new convenient online monitoring system for IoT based on cloud computing.

After accumulating enough data from an agricultural IoTs system, the modeling of relevant functional requirements was demonstrated to promote the application of big data analytics in agriculture.

RESULTS AND DISCUSSIONS

Data analysis has the following advantages: graphical visualization of the data that the server receives from the GPS devices installed in the cars; receiving data from many different software, generating different charts and graphs according to set criteria; view data in real time; access to information both on your computer and on your tablet or mobile phone at any time of the day; ability to analyze and review historical data; option to connect to other programs and integrate data from files into a database; selection of information by several filters (period, driver name, car, inventory, etc.); availability of current detailed views by car acreage, driver acreage, motorcycle hours and fuel (Lobachevsky YP, 2016).

A fleet management system consists of a GPS monitoring device, various sensors and a software part for data interpretation.

Fleet management is the activity of managing motorized machinery and more (*figure 2*), such as cars, trucks but also agricultural or construction machinery to achieve optimal use, with the best possible fuel consumption and low maintenance costs.

In the agricultural field, such a system helps in following the work plan, the work steps established by the management factors in the farm, additionally.

At the same time, farmers ensure that the optimal number of resources (people, machinery) are allocated at the right place and time. Thus, efficiency increases and costs are reduced.

There are numerous Decision Support Systems (SSD) aimed at assisting decisions in agricultural issues. Some are based on data others on models. A decision support system produces detailed information reports by collecting and analyzing data. Therefore, an SSD is different from a normal operations application, whose purpose is to collect data and not to analyze it.

The components of a decision support system are: the model management system stores models that managers can use in decision making.

The models are used in making decisions about the financial health of the organization and forecasting the demand for a good or service; the user interface includes tools that help the end user of an SSD navigate the system; the knowledge base includes information from internal sources (information collected in a transaction process system) and external sources (newspapers and online databases).

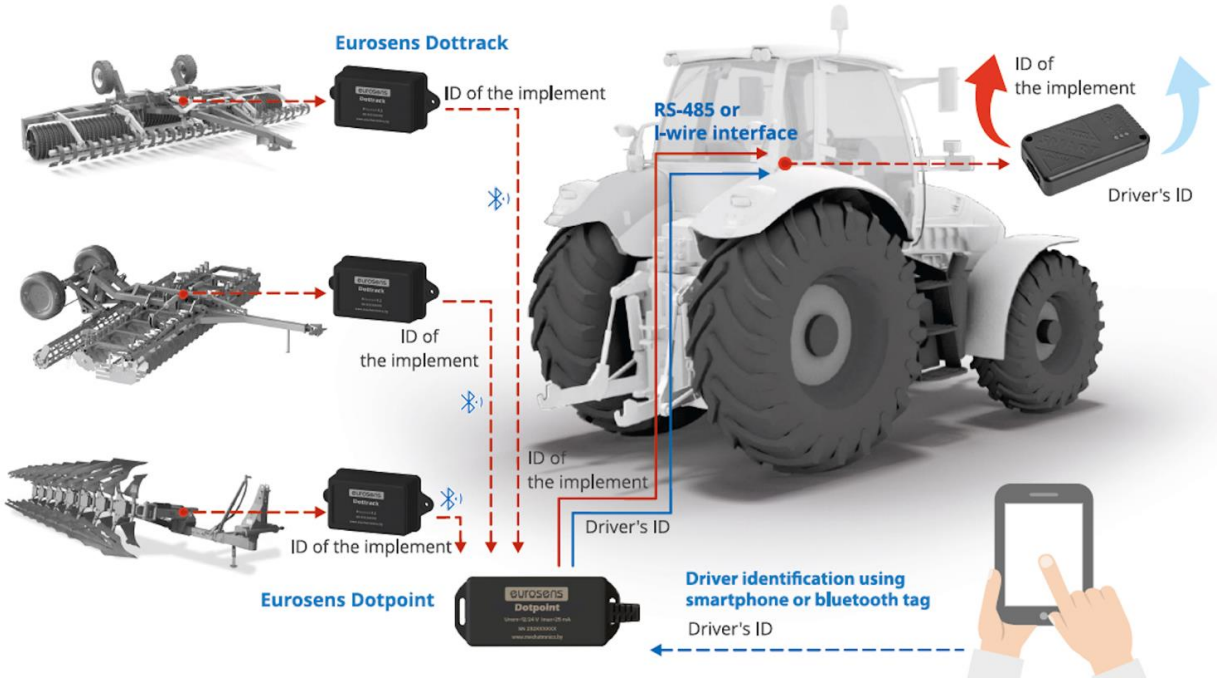

Figure 2 **Driver and equipment identification system for agricultural machinery**

The benefits that can be obtained from farm technology are optimizing costs: lowering costs per hectare by applying fertilizers and protective substances and treatments exclusively on problem areas, knowing each plot in detail: for each individual plot, data related to soil, positioning, as well as climatic trends can be monitored, which helps to optimize and maximize agricultural production. during the year you can observe the work on each plot and you can also identify the differences in plant growth or agricultural production, depending on the applied technologies; work efficiency of employees: monitoring working time for employees, day laborers and mechanizers, helps you to measure and increase the productivity of people with agricultural works; permanent information of the farmer: monitoring systems for machinery and aggregates provide farmers with modern management technologies that provide them with detailed and real-time information on the crops managed. Thus, farmers can maximize their profit, have more predictability regarding the evolution of crops, but also make sustainable agriculture.

The Internet of Things (IoT) describes physical objects (or groups of such objects) with sensors, processing capability, software, and other technologies that connect and exchange data with other devices and systems via the Internet or other communications networks. The Internet of Things has been considered a misnomer because devices do not need to be connected to the public Internet, but only to be connected to a network and individually addressable.

IoT is an environment in which objects, animals or people are equipped with unique identifiers capable of transmitting data through an Internet network without the need for human-human or human-computer interaction. More than 13.4 billion devices were connected to the Internet as part of the IoT in 2015.

IoT smart farming solutions are a system built to monitor the crop field with the help of sensors (light, humidity, temperature, soil moisture, crop health, etc.) and to automate the irrigation system.

Applications of technology in every field of agriculture are used to improve the yield or quality of crops and to reduce costs. The application of WSN in precision agriculture assists farmers statistically, helping them make better and well-informed decisions.

The proposed IIS combines IoTs, Cloud Computing, Geoinformatics (RS, GIS and GPS) and e-Science for environmental monitoring and management, with a case study on regional climate change and its ecological responses, which is one of the hottest issues in the scientific world.

CONCLUSIONS

Farm management data helps so that the decisions are made based on the information available at the time: Decision making is one of the most important duties of managers, and they do it all the time. The correctness of decisions depends to a large extent on the information available at the time of decision, so in order to make good decisions, it is important to have the correct information.

The correctness of the data can ensure the correctness of the information by collecting it from as many sources as possible and storing it in a structured database that allows search, simple and real-time analysis.

Storage systems should be simple and easy to use with an easy-to-understand interface. At the same time, it is important that the systems work in parallel, in the cloud, so that each user enters the data they have at their disposal as close as possible to the place and time when the event happens.

The collection of consumption data, correlated with the worked surfaces, quickly brings a clear view of consumption and efficiency. Collecting scale data and automated inventory management benefit just as quickly. Information about the performance of hybrids, efficiency and impact of inputs takes time and for the best decisions also requires a data set collected in different weather conditions.

Data security is mostly given by its source and its verification/testing. The most reliable data are those produced and collected directly from other computer systems, collected directly from the tractor, machines, weather stations.

ACKNOWLEGMENTS

The realization of the study is part of the project *The constitution and implementation of partnerships for knowledge transfer between the Research Institute for agriculture and the environment of Iași and the agricultural economic environment* with SC Agromec Dragalina SA – Contract POC-A1-A1.2.3-G-2015, ID P_40_385, nr. 4/05.06.2018.

REFERENCES

Cazacu D., 2021 – *Agricultura de precizie, Iași.*

Lobachevsky YP, 2016 - *Methodical recommendations on the implementation of monitoring systems and management of harvest-transport complexes* / co-authors: FSBI FNATS VIM. M., 2016.107 p.

Marcal D., 2020 – *Digital Agriculture, Berlin.*

Matthias N., 2020 – *Handbook Digital Farming, Berlin.*