torque and high-speed capability in the same machine at levels greater than twice that of the electric motor industry's best-performing motor technology.

Electric motor technology is an exciting breakthrough, though it is an advanced engineering project that might not result in a marketable product for 10 years. But it is the future of agriculture as electric motor technology offers the prospect of greater fuel efficiency and reduced emissions. In spite of challenges, this concept deserves more press. The farm of the future will be a self-sustaining energy system, creating energy from wind, solar, and anaerobic digesters, and storing such energy in batteries on the farm. And that's why Deere's all-electric concept is potentially a breakthrough. Farms will someday become energy producers in much the same way they produce food. Having a farm vehicle that can do the work and be powered by on-farm energy sources helps get us to that holy grail in farming – sustainability.

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ARTIFICIAL INTELLIGENCE IN AGRICULTURE

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Abstract. Artificial Intelligence-driven technologies are emerging to help improve efficiency and to address challenges facing agriculture. Agricultural robots are poised to become a highly valued application of AI in this sector.

Keywords: Artificial Intelligence, automation, autonomous tractor, human-operated tractor, robotic equipment, digital agriculture, soft robotics, combine harvester, collision, self-driving tractor, crop yield.

New agricultural technologies and techniques have staved off the sharp famines. Though once humans had to plant seeds haphazardly by hand, seed drills enabled farmers to sow them in long, uniform lines. With steam-powered tractors, farmers could plow wide swaths of land, without the need for sluggish oxen. Threshing machines cut down the many hours devoted to threshing by hand.

With the world population climbing to ever more staggering heights, and with economic growth allowing for greater consumption, the world may need another agricultural revolution to sustain itself.

One answer to the problem may lie in automation. While agriculture has become increasingly automated over the last 200 years, the process is only accelerating. New technologies and drones in particular, are allowing farmers to improve the efficiency of their crops and livestock production, as well as quickly neutralize threats such as disease or drought. The aim of this research is to determine the future of Artificial Intelligence in agriculture.

While full automation is often hailed as the ultimate aim in technological development, and the future agricultural systems may look very different from those of today, only very few large companies can afford the disruption of full automation. So to achieve this long-term vision will require a gradual transition from the current farming practices, and most farmers will need technologies than can be introduced step by step, alongside and within their existing systems. Furthermore, while some emerging robotic technologies are already achieving or approaching the robustness and cost-effectiveness required for real-world deployment, other technologies are not yet at that stage. For example, soft fruit picking still requires fundamental research in sensing, manipulation and soft robotics.

Perhaps the most iconic farming vehicle, the tractor, is undergoing a transformation of its own. Autonomous tractors, such as Case IH's Autonomous Concept Vehicle, could replace human-operated tractors on many farms. The sleek machine does not even have a seat for a driver. It can travel along predetermined routes programmed by its operator, who can track the tractor's movements and reroute it, if need be, with a tablet app. The tractor can even sense obstacles in its path, stopping to avoid collisions. Autonomous tractor manufacturers such as New Holland even claim that the vehicles will eventually be able to react to changes in the weather [1].

Tractor companies have long been a hotbed of innovation, but over the past few years of the rapid development of autonomous Artificial Intelligence (AI) the industry has seen a quantum leap in technology that will quickly change the nature of farming.

Long established companies like Kubota, Case, New Holland and John Deere have all brought out fully autonomous tractors between 2015 and 2018, but new players like Autonomous Solutions Inc. are also bringing stunning new developments to farms, orchards and vineyards. In one startling experiment in Shropshire, England last summer an entire field of barley was planted, tended and harvested using nothing but robotic equipment [1].

The 'Hands Free Hectare' project was set up in October, 2016 by a team from Harper Adams University. They modified a tractor and combine harvester with cameras, lasers and GPS systems to create equipment that could do the job with no human intervention [2].

Autonomous drones and a small robot scout on the ground handled the monitoring of the field. While the Hands Free Hectare was an experiment, Kubota tractors are now hitting the ground in Japan this year with full-fledged sales of self-driving tractors, following trials last year. Because the tractors need to be monitored, Kubota assumes the farmers will operate two tractors in tandem, one with a driver and the second using the Kubota Smart Agri System (KSAS) to drive itself and operate the machinery independently.

John Deere has been working on self-driving tractors for two decades now, having built its first autonomous navigation system way back in the 1990s. Dan Leibfried, Director of embedded solutions at John Deere's Intelligent Solutions Group, says total autonomy is still some years away, as self-driving systems don't have either the intelligence or the senses of a human being [2].

«We have to have the ability to sense everything the human would inside of the system related to the quality of the job», said Leibfried. «Whether it be preparing the soil, planting the seed, protecting the crop, or harvesting it». [2]

For now, John Deere's self-driving tractors still must have a human in the cab to make sure nothing goes wrong, even though they can function without human input [2].

One of the companies doing the most work on self-driving tractors is Autonomous Solutions Inc., which unveiled new concept tractors in partnership with CNH Industrial, the maker of both Case and New Holland tractors.

The one that really turned heads was a Case IH Magnum tractor unveiled at the Farm Progress Show in Boone, Iowa last August. What blew people's minds was that the sleek, futuristic machine had no cab for a human driver. It is designed to only work on its own, though it can be sent instructions remotely through computer tablet software [3].

AI-driven technologies are emerging to help improve efficiency and to address challenges facing the industry including crop yield, soil health and herbicide-resistance. Agricultural robots are poised to become a highly valued application of AI in this sector.

Crop and soil monitoring technologies will also be important applications' going forward as climate change continues to be researched and evaluated. One research study reported that climate change evaluated from 1980 to 2008 resulted in a 3.8 percent global reduction of maize and a 5.5 percent reduction of wheat [3].

The amount of data that can potentially be captured by technologies such as drones and satellites on a daily basis will give agricultural business a new ability to predict changes and identify opportunities. We predict that satellite machine vision applications (for weather, crop health, predicting crop yield, etc.) will become more and more commonplace for large industrial farms in the coming 5-10 years [3].

It will be important that farmers are equipped with training that is up-to-date to ensure the technologies are used and continue to improve. This will help to prove the value of these tools over the long haul.

Hypothetically, it is possible for machines to learn to solve any problem on earth relating to the physical interaction of all things within a defined or contained environment by using artificial intelligence and machine learning.

The rise of digital agriculture and its related technologies has opened a wealth of new data opportunities. Remote sensors, satellites, and UAVs can gather information 24 hours per day over an entire field. These can monitor plant health, soil condition, temperature, humidity, etc. The amount of data these sensors can generate is overwhelming, and the significance of the numbers is hidden in the avalanche of that data.

The idea is to allow farmers to gain a better understanding of the situation on the ground through advanced technology (such as remote sensing) that can tell them more about their situation than they can see with the naked eye. And not just more accurately but also more quickly than seeing it walking or driving through the fields.

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MAINTENANCE OF FARM MACHINERY

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Abstract. The article is headlined maintenance of farm machinery. It deals with farm machinery costs. The main factors from which farm machinery must be protected and objectives of good maintenance practice are defined. A lot of attention is paid to various types of farm machinery maintenance.

Keywords: maintenance, farm machinery, agriculture, farm machinery costs.

Today farm machinery is considered to be one of the most important power sources in agriculture. Effect of machinery power on agriculture is considerable. The use of modern technology during last decades has resulted in rapid growth of farm production. Farm machinery is important example of this mod-