

FUTURE OF FARMING – AUTONOMOUS ELECTRIC TRACTORS

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John Deere, probably the largest manufacturer of agricultural machinery in the world, has been showcasing a new autonomous tractor and other new technology at the ongoing Agritechnica event. In a new exhibition concept at this year's Agritechnica, Deere is demonstrating its leading position in precision agriculture in the Future Technology Zone. Nine different product developments and research projects in the fields of electrification, autonomy through automation and artificial intelligence show how agriculture could work even more sustainably and productively in the future.

ELECTRIFICATION–

Zero emission compact utility tractor: This electric compact tractor is based on the John Deere 1 Series. A key feature of this machine is its high PTO power, allowing more than 10,000 m² of lawn to be mowed with one battery charge lasting four-and-a-half hours.



The John Deere stand at Agritechnica In addition to high performance, customers benefit from very low maintenance costs. Potential applications are mainly where low noise levels and emission-free operation are required.

eAutoPower TRANSMISSION:

eAutoPower is the first continuously variable transmission with an electro-mechanical power split. Compared to conventional CVTs, the drive is more efficient and wear-free. Another special feature is the provision of up to 100kW of electrical power for external consumption.

To demonstrate this, John Deere and Joskin have developed a slurry tanker with two electric drive axles. Thanks to this eight-wheel drive system, much more efficient transmission of tractive power is possible. This can also reduce slurry incorporation costs by up to 25 per cent.

AUTONOMY THROUGH AUTOMATION– Autonomous electric tractor:

John Deere's new autonomous tractor concept is a very compact electric drive unit with integrated attachment. The tractor has a total output of 500 kW and can be equipped with either wheels or tracks. Flexible ballasting from five to 15 tonnes is possible, depending on the application, to help reduce soil compaction. Because of its electric drive, there are no operating emissions and noise levels are extremely low. Further advantages include low wear and maintenance costs.

Semi-autonomous tractor:

This tractor drives semi-autonomously and is equipped with an integrated crop sprayer. Using a built-in camera, it is possible to work in row crops – for example, applying plant protection products to fruit tree plantations. Filling the sprayer tank takes place fully automatically at a filling station, so the user is not exposed to pesticides. This is designed to reduce costs and increase productivity by over 30 per cent.

Autonomous drone sprayer:

This drone is equipped with a weed scanner and crop sprayer, allowing weeds to be scanned from the air and then specifically controlled. The 10.6-litre tank is filled fully automatically at a field boundary station, where the automatic battery charge also takes place. Flight time with a fully charged battery is 30 minutes. The main advantage of this drone is the precise application of pesticides, which significantly reduces the amounts used. Spraying from the air is also possible regardless of ground conditions.

Autonomous sprayer:

This novel autonomous sprayer has a 560-litre spray tank. The high ground clearance of 1.9m and four-wheel steering make it extremely versatile, while the tracks minimise ground pressure and greatly extend the operating window.

ARTIFICIAL INTELLIGENCE

Blue River Technology:

With See & Spray technology, high-resolution cameras capture 20 images per second. Based on the images and artificial intelligence, the system recognises the difference between cultivated plants and weeds so that individual plants can be specifically treated. With this new generation of weed control, the use of pesticides can be greatly reduced.

The AutoNxt team at the Mumbai office, which also doubles up as their technical and research centre. This became the inspiration for AutoNxt, which has developed India's first electric autonomous tractor, called 'The Hulk'.

Command Cab:

The future vision of a driver's cab reveals new possibilities for artificial intelligence. With its joystick control, touchscreen display and networking of all machine components, John Deere presents a completely new operating concept. By integrating real-time weather data, individual pre-settings and job management procedures, the cab becomes the command centre for agricultural operations.

Large spraying drone – VoloDrone:

The large drone developed jointly by John Deere and Volocopter has a diameter of 9.2 m and is powered by 18 rotors. It has a fully electric drive with replaceable lithium-ion batteries. One battery charge allows a flight time of up to 30 minutes, and the VoloDrone can be operated both remotely and automatically, on a pre-programmed route. The drone frame is equipped with a flexible standardised payload attachment system. This means that different devices can be mounted on the frame, depending on the application. For crop protection, the large drone is equipped with two liquid tanks, a pump and a spray bar.

Mumbai-based AutoNxt claims the 30hp Hulk is the world's first autonomous electric tractor. The Level 2 autonomous farm equipment has a range of 150km per charge and can perform a variety of farming functions.

It took a year for the 'Hulk' to go from proof of concept through to prototype stage.



It may be recollected that in September 2017, Mahindra & Mahindra revealed its first-ever driverless, non-electric tractor, developed at the Mahindra Research Valley. AutoNxt was set up in January 2016 by Kaustubh Dhonde, a 24-year-old electronics engineer. The idea to automate the tractor came to Dhonde when he visited a relative, who is a farmer. He says that when his uncle decided to sell his one-year-old tractor, he was shocked to know the stark reality of the farming community. He explains: "Owning a tractor involves a lot of expenses and health issues; one of the major operational costs is hiring a skilled driver."

claimed to have one of the highest life-spans. Dhonde, however, was tight-lipped as to the details of the technology. The company has incorporated electronically controlled hydraulics that can be adjusted for different functions. The rechargeable battery, which comes with an inbuilt charging socket, can be charged using any conventional charging point. AutoNxt claims the battery life is around 10 years, and compared to fuelling up a conventional 30hp tractor which costs around Rs 1,500, the charging cost will be around a third of that for 0-100 percent charge.

HOW THE 'HULK' TOOK SHAPE

What started as a concern turned out to be a solution in disguise for the young engineer. Dhonde says he started discussing the idea with his peers in 2015 during his college days and eventually was convinced that the underlying issue needed to have a much more holistic and realistic approach. By December 2015, he had developed a concept idea on how to translate his learning into a product solution. In January 2016, he undertook a survey covering 212 farmers in four states – Maharashtra, Punjab, Gujarat and Karnataka. Following this, the company started experimenting with GPS technology on small robotics that would help them in product development.

Then, a gritty Dhonde, along with his founding team, started providing GPS tracking services to various clients to raise investments for their core project – an autonomous-electric tractor. In January 2017, the company successfully showcased its first proof of concept of its autonomous driving capability to a bunch of potential investors at a mere expense of Rs 50,000. Dhonde explains, "When we developed the first prototype technology, we realised the cost of buying a second-hand tractor or even renting it would be quite high. Fortunately, one farmer was quite curious and helped us by giving his tractor on rent for free."

The prototype Hulk, which is a 30hp, Level 2 autonomous electric tractor, is capable of delivering a range of around 150km per charge. It can perform various functions like ploughing, tilling, disking, insecticide spraying and others, just like a conventional tractor. The Hulk uses a proprietary battery technology which is lithium-based and

ALT. CONTROL. AUTONOMOUS.

According to Dhonde, initially setting up the autonomous function requires the farmer to manually drive the tractor around the borders of his farm to feed-in the data to the autonomous tractor. Once the data is fed in, the farmer using his cellphone or tablet can define the path, function and let the tractor do its work.

From the safety perspective, the tractor has a kill-switch which can be activated either by pressing the button on the tractor or the app in the phone/tablet, which will halt the tractor in its tracks. To make sure that the autonomous driving capability cannot be misused, controlling the tractor remotely can be done in a specified range only and authentication for remote controlling has several safety features. The company states that in India where tractors are also used by households as a passenger transport vehicle, they have made sure that the vehicle's autonomous driving capability cannot be employed on roads.



Kaustubh Dhonde, Founder and CEO, AutoNxt

According to Dhonde, the survey highlighted that in India where a huge section of farmers have small or medium landholding, the 30hp tractor is the best fit for their needs. "As per our findings, the 30hp tractor is well suited for our initial offering. Later on, we can expand our range depending on the needs and findings we come across," explains Dhonde.

THE ROAD AHEAD

According to Dhonde, the company is already in advanced talks with leading tractor manufacturers in India, for collaboration. He states that while AutoNxt will act as the technology provider, the established OEMs will produce and use its distribution network that will act as a win-win situation for the partners. When asked if the company would look at producing the tractor itself, Dhonde says, "We are more of a technology company, we would like to focus there. But in case there is a disagreement for this kind of collaboration, we would explore taking a contract manufacturing route."

He is also planning to get the first prototype ready and get the necessary approval/certification done to begin the commercial rollout by 2022. He is also optimistic about the government's support for electric vehicles to play a key role in the adoption of the e-tractor in India.

