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Challenges in Introducing Autonomous Tractors for Future Smart Farming

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ABSTRACT: ***A new innovation frontier is emerging as agricultural and digital technology converge, opening up several avenues for the development of smart farming in the future. A turning point in human history was the advent of agriculture. The first significant shift in the connection between completely modern people and the environment occurred when humans were able to manipulate the environment to produce enough food to support rapid population increase. The development of Agriculture sparked a broad range of innovations, from the use of fire and prepared meals to self-driving machinery. Farm automation still presents several difficulties that must be solved. Out of farm equipment which are made to be automated or in line for future automation, autonomous tractors are one of the breakthroughs. However, this automation also brings challenges. Therefore, this paper aims to highlight the challenges that are faced by driverless tractor in modern age of farming.***

KEYWORDS: ***Agriculture, Automation, Autonomous Tractor, Equipment, Technology.***

1. INTRODUCTION

Innovators are frequently clueless. They frequently expect new technology to do the same functions as old technology, just better and cheaper. They are frequently extremely slow to see the new technology's ability to perform things that the old could not. Early tractor builders, for example, desired a machine that was stronger than a team of horses and less expensive to maintain while performing roughly the same function as flesh and blood horsepower. It took them a while to discover that they weren't constrained by the restrictions of animal traction, which could only supply draught drawing power and turning power via ground driving wheels. Tractors had more power as well as more controlled mechanical power (e.g., power take off (PTO), hydraulics) [1].

Farmer production has always been a goal throughout history. Around 5500 BC, Sumerian farmers created the earliest agricultural tools that have been documented. The forked sticks were used to construct a prototype plough. The plough made a trench where seeds could be sown as it was dragged across the earth. Since 5500 BC, a great deal has changed. The need for better techniques, however, is still present among farmers. Farmers that can obtain the best yield at the lowest cost are the most successful because they can set the highest standard for output [2]. We are in the "Fourth Industrial Revolution" right now. Our state-of-the-art farm machinery makes use of automation, artificial intelligence, and pervasive digitalization. the self-driving tractor[3][4]. Numerous production issues, including a lack of manpower, climate change, and others, plague modern farms. Through technical advancements, the industry has stayed ahead of these difficulties

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for a number of decades. The main change in this tale is the introduction of autonomous tractors. In the years to come, their entrance to the sector will aid in maximizing production (Figure 1).

Figure 2: A Pictorial Representation of Driverless Tractor during demonstration in 1958 (Google).

One of the next precision agricultural breakthroughs might fall victim to this mishap. Stories of self-driving tractors and other machinery are beginning to appear in agricultural and commercial magazines. Typically, the depiction is of a traditional machine with the driver replaced by a combination of global positioning system (GPS), computers, and electronic sensors. The advantages of this strategy often center on increased production because[5].

1.1. Emerging Liability Issues

Insurance companies would definitely need that a driver be present if autonomous technology ever became commercially accessible, even if it was just to turn off the switch in case of a problem. This one again highlighted how a driver would drastically decrease the advantages of this technology. Even if the driver is merely present for safety purposes, he or she may still become unwell, become overworked, or want a break. A seat, cab, and controls must be made available if the driver is reinstalled [6].

The question of responsibility actually has something to do with how this technology is received in society. Community acceptability is a problem with every new technology, but it usually becomes more crucial when the new technology requires significant changes in long-established patterns of life or appears to pose a risk to physical safety. The introduction of tractors and cars was not universally welcomed. Horses were terrified of moving objects. Some others considered them to be a safety risk. Horse breeders saw from on that the advent of motorized transportation would spell their doom. The conversion of grain into pork is now done with great efficiency in modern hog facilities. Financing is available. The biggest obstacle that investors who want to

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construct new hog facilities frequently face is persuading the local community to allow them to do so.

Will people someday grow acclimated to self-driving farm equipment? They would undoubtedly get more habituated with time, but only after insisting on a number of safety precautions. Aside from requiring the rider to deactivate the equipment, there may be legal requirements that fields farmed with remote control equipment be gated to prevent youngsters from wandering into the path of the equipment. This would make the autonomous equipment in the field more similar to the manufacturing robot. Extra safety procedures may be reasonable for high-value crops, such as biotech pharmaceutical crops, but they may be too expensive for bulk commodities.

1.2. The Paradigm Shift

The liability and safety issue is mostly a matter of perception. It stems from a concern about heavy machinery operating in public without any discernible human supervision. Here, size is a problem. The public would be significantly less alarmed by a cute R2D2-style robot working in the fields than by a remotely controlled 4WD tractor pulling a 40-foot tool at 10 mph. The irony of this finding is that bigger agricultural equipment isn't necessarily better after the driver is gone. One of the key benefits of motorized mechanization was that it increased the amount that one person could achieve.

Imagine a farming system where the majority of the labor-intensive tasks are carried out by tiny robot-like robots, or "droids," to borrow the Star Wars nomenclature. Depending on the size of the field, each one might have one or more. The equipment might be kept in the field for the whole growing season, housed in a barn in the far corner, and operated with orders from the field office or possibly from a computer in the truck. The devices would be small enough to transport in the back of a pickup truck for extremely small fields (like those in suburbia, for example). The act of bringing the equipment to new areas and starting it to work is a routine farm management task [7], [8].

For row crops, it is probable that the machine could work on one or two lines at a time; however, the ideal area that each unit would cover in one pass is a technical matter that would likely depend on the crop and the equipment design. The machine can operate continuously, paying meticulous attention to each row since it does not get tired or need pauses. As it effectively permits mass planting, this may be the organic farmer's ideal situation. You could either hoe or pull weeds. Crushed after being removed one by one. For agricultural operations, this kind of technology would have far-reaching effects. On a sizable farm in the Midwest, it could be time for planting. Numerous machines may be planting at once on a single farm, up to and including thousands [9].

2. DISCUSSION

Farmers have a significant barrier to entry due to high adoption costs of robotic technology, particularly in developing nations. Robotic planters, for instance, must carry heavy loads of water or pesticides; hence, the gear must be made differently, which increases the cost to make it larger. High repair expenses are also associated with such specialist equipment when it comes to technical problems and equipment failure. Farmers will need to combine their expertise and experience with these new technology in order to properly exploit farm automation[10].

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Driverless in urban and rural settings is frequently compared, and there are discussions concerning it. Despite the fact that agricultural regions tend to have less risky scenarios that is, better regulated spaces, limited human mobility, and fewer obstructions there are still additional challenges. In contrast to a truck or a car, agricultural machinery is always used for extra tasks in addition to transportation. In other words, a tractor constantly operates a sprayer, a fertiliser, a planter, and other machinery that each has complicated requirements for automation and autonomy.

Today, we have the vision and are working to establish processes that are autonomous in addition to automobiles. Machines are among the resources that need to evolve in accordance with the trajectory of their autonomy. They aren't the only ones, though; other fleet components must also be coordinated, logistics tools and strategies must be used, and intermediate- and long-term planning must be done in order to allow for the processes to be effectively autonomous and for the producer to experience greater gains in efficiency. Humans still need to get beyond some challenges. Connectivity is a significant barrier in agricultural regions, as is well known.

Along with all essential technological advancements to guarantee the highest standards of safety, the introduction of autonomous tractors will also be subject to the appropriate legal constraints. The modern era headed in the right direction and that this future will come far sooner than anyone could have anticipated. Researchers will continue successful goal of enhancing agricultural production's efficiency through the autonomy of machines and systems step-by-step, gradually, and in line with the development of the technologies.

3. CONCLUSION

Although there are compelling arguments against autonomous farm machinery simply substituting a computer for the driver, it is possible that such technology may one day be a reality. It can include reevaluating the methods used in agricultural production. In instance, bigger is not always better if the driver is no longer required. A swarm of little machines may be more effective and less expensive at producing crops than a few giant ones. The fact that the smaller machines can be more popular outside of the farming sector is one of their benefits. Through improvements in production methods, software, and technology, it provides a route towards sustainable and more effective agriculture. The sophistication of automation technology is increasing yearly, and what was cutting edge only a few years ago will soon be ordinary and affordable. Although completely autonomous cars and agricultural machinery are on the way, maintaining a farm will always include humans.

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