

"Green Patronus"--Multifunctional Planting Machinery

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Abstract

In response to the "3060" dual-carbon goal proposed by my country, although my country has taken many measures to reduce carbon emissions, a multifunctional planter has been designed to solve the problem of land desertification and respond to the national dual-carbon policy. The planter consists of a traveling part, a rotating part, a lifting part, a grasping part, etc. Through the organic combination of each part, it can automatically identify the sowing environment, grab the seedlings for sowing, and automatically cover soil and water. The general appearance is based on the trolley and then adds other functional components, such as the use of the automatic rotation device of the worm gear to update the seedlings in time, and the lifting part and the grasping part to realize the function of watering and soil compaction.

Keywords

Multifunctional Planter; Automatic Identification; Worm Gear Drive.

1. Introduction

With the development of science and technology and social progress, intelligent equipment has gradually penetrated into all aspects of people's lives. my country has a vast territory, and there will inevitably be arid or semi-arid areas. In order to prevent land desertification and protect farmland, pastures, traffic and settlements from the hazards of wind and sand flow and sand dunes, it is very necessary to carry out windbreak and sand fixation. The survey found that although my country has done a lot of work on windbreak and sand fixation, it is still lacking in some aspects. For example, when it comes to planting trees to protect against sandstorms, smart devices are not yet widespread. At the same time, it is found that the survival rate of saplings in the desert is also low, which is undoubtedly a waste of human, material and financial resources. The survey also found that the poor ground stability of the desert and the strong wind and sand make it difficult for saplings to survive.

China is one of the countries with a large area of desertified land and the most serious harm in the world. The national desertified land area is 2.622 million square kilometers, accounting for 27.3% of the total land area. Mainly distributed in the northwest and north of North China, involving 18 provinces, autonomous regions and municipalities directly under the Central Government. Desertification has had a serious impact on my country's industrial and agricultural production and people's lives. Experts estimate that the economic loss caused by desertification in my country is as high as 54 billion yuan every year. In some areas where desertification is seriously endangered, the problem of food and clothing for the masses has not been completely solved. At present, the general trend of desertification in the country is as follows: desertification in some areas has been effectively controlled and remarkable results have been achieved, but it is still expanding and deteriorating on the whole. The situation facing desertification control is still very serious.

Therefore, in response to the above problems, we designed a multi-functional planting machine according to the needs. The device adopts an intelligent seeding mode, which integrates automatic identification, planting, soil filling, watering and other functions. It liberates

manpower and improves the survival rate of saplings. It is a powerful and cost-effective tree planting machine. to solve the above problems.



Fig 1. Traditional semi-automatic planter

2. Overview of Research at Home and Abroad

The development of facility seedling transplanters began in the early 1990s, some colleges and universities in Japan and the United Kingdom carried out research on the transplantation technology of plug seedlings and tissue culture seedlings. In the late 1990s and early 2000s, the old Dutch production equipment manufacturers Visser Company and TTA Company began to After more than 20 years of development, a number of European facilities transplanting machine manufacturers have emerged, such as Flier, Daros, Ubinati, Tea Project, etc. The functions include plug seedling transplanting, plug seedling grading, and plug seedling picking. The seedling supplemented seedlings have been expanded to grading transplantation and substrate-free bare seedling transplantation. At the same time, for the automatic transplantation operation, paper pot seedlings, high-foot plastic hard plug trays, and rigid cutting seedling belts have been developed to assist the transplantation operation, which improved the cutting operation. Quality and operational productivity have driven the development of facility-produced seedling transplant technology.

The domestic plug seedling transplanting technology started late, and the facility horticultural species

The planting mode is not uniform, the degree of production standardization is not high, and there are differences with the production materials used in foreign facility gardening, so it is difficult to directly introduce foreign equipment. Under this circumstance, in the late 2010s, Shenyang Agricultural University, Nanjing Agricultural University, Beijing University of Technology, South China Agricultural University, Zhejiang University, Zhejiang Sci-tech University and other colleges and universities carried out various researches on the transplanting hand of plug seedlings. The University of Technology, South China Agricultural University, Zhejiang University and Zhejiang Sci-tech University also successively launched the plug-in tray transplanter test prototypes. In the late 2020s, Beijing University of Technology, South China Agricultural University and Zhejiang Sci-Tech University successively launched plug-plate seedling transplanting machines for planting hydroponic leafy vegetables, the performance of which is basically the same as that of foreign products.

At present, foreign research starts earlier than domestic research, and there are still many key technologies in domestic production practice that need to be studied. The research on automatic tree planting machines at home and abroad is generally applied in the fields of agriculture and gardening, and there is no mature research on the machinery for desert

planting. In desert planting, the related machinery for laying grass squares is mostly used, and multi-functional planting machinery has not been applied in desert planting yet. To sum up, our automatic tree planting is different from the existing planters, mainly suitable for desert planting, and innovatively made structural and functional changes to make it suitable for desert demand, making the use of fully automatic machinery to plant trees in deserts a reality.

3. Model Introduction

This work provides a multifunctional planting mechanical device based on the fischer model, which solves the existing problem of automatically planting seedlings in desert environments. To solve the above technical problems, this work provides a multi-functional planting mechanical device based on the fischer model, including: a traveling part, a rotating part, a lifting part, a grasping part, etc. Through the organic combination of each part, it can automatically identify the sowing environment, grab the seedlings for sowing, and automatically cover soil and water. The general appearance of the work is based on the trolley and then adds other functional components, such as the use of the automatic rotation device of the worm gear to update the seedlings in time, and the lifting part and the grasping part to realize the function of watering and soil compaction.

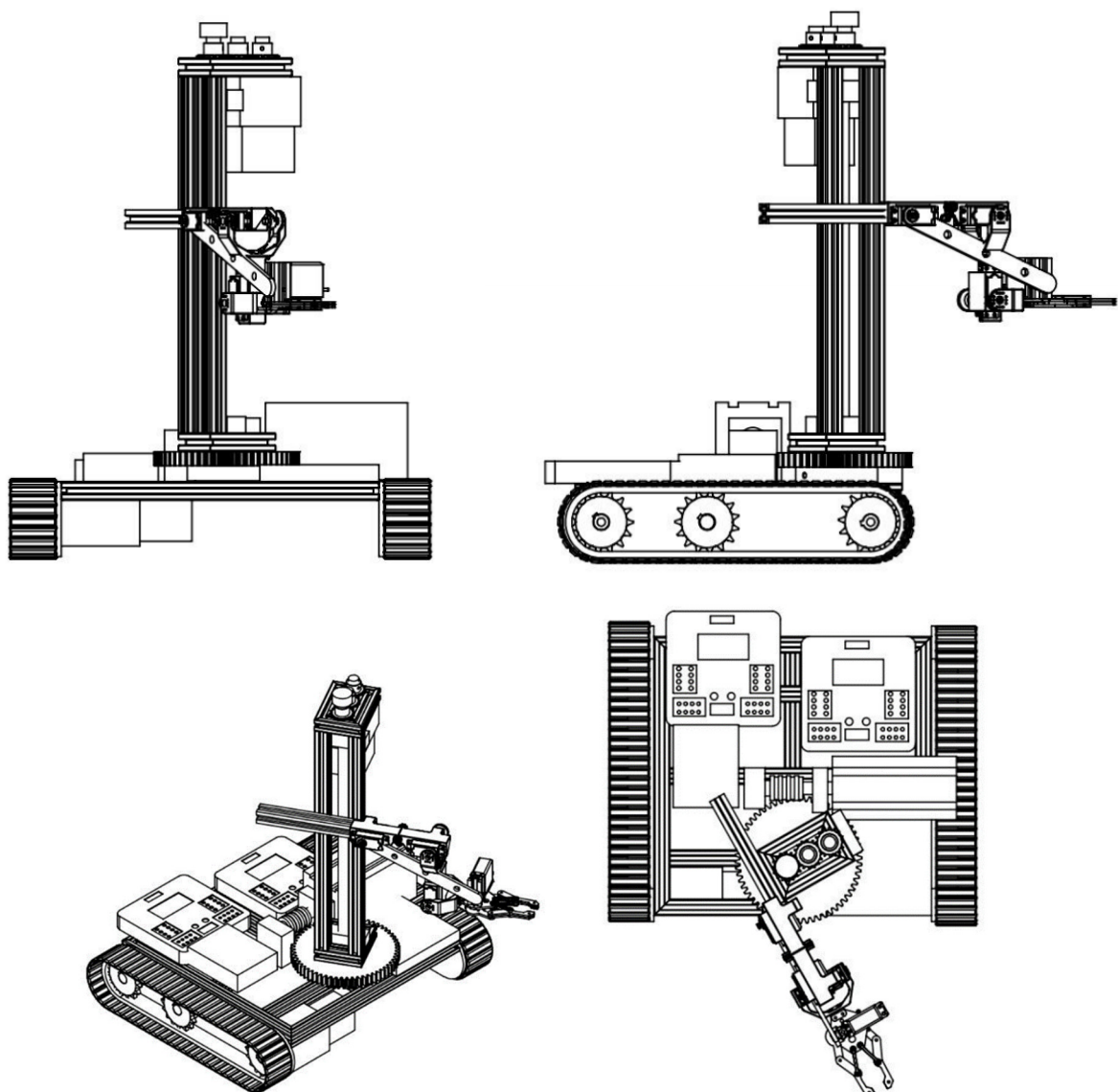


Fig 2. Design of multifunctional planting machinery

Planting mode

At the beginning of planting, use the chain drive to drive the tree planter to run. When it travels to the designated position, the tree planter automatically recognizes the icon and stops, grabs the sapling placed on the tree planter, lifts and rotates, and puts the sapling into the designated position.

Fill mode

After the saplings are placed in the holes dug in advance, the soil is compacted to enhance the stability of the ground. This method can make the survival rate of the saplings as high as 90%.

Alarm Mode

When the trees on the device have been used up or the saplings have been planted in the desert in this area, it can automatically alarm, so as to replenish the new areas in time to continue planting saplings.

4. How the Multifunctional Planter Works

4.1. Implementation Process

1. Identification: Use the eddy current sensor to measure the distance between the height of the machine body and the ground to identify the planting environment.
2. Planting: At the beginning of planting, use the chain drive to drive the tree planting machine to run. When it reaches the designated position, the tree planting machine automatically recognizes the icon and stops, grabs the sapling placed on the tree planting machine, and lifts and rotates to remove the sapling. into the designated location. Put the seedlings into the excavated soil pit, and the automatic planting machine can automatically replenish the seedlings to the pre-placed position for the next planting. At the same time, this part uses the temperature and humidity sensor to measure in real time and transmit the data to the host computer through wireless bluetooth. The operator can analyze the data and modify the control strategy, such as the water supply of seedlings.
3. Filling and watering: After the seedlings are placed in the holes dug in advance, the soil is compacted to enhance the stability of the ground. This method can make the survival rate of the seedlings as high as 90%. After the seedlings are put into the soil pit, the soil pit is filled and compacted by the soil compaction device with the lifting function using the screw drive to ensure high transmission efficiency, and the degradable film containing water and nutrients is grabbed and injected into the soil pit. It can complete the supplement of water and nutrients required for the growth of seedlings. The quality of the material contained in the film is controlled and adjusted by the operator.
4. Seedlings update and feedback: When the smart sensor detects that the planted seedlings and their nutrients are exhausted or the required planting area has been planted, the device can automatically send a signal to the operator, waiting for the operator to further Operation to facilitate timely replenishment or to continue planting new seedlings in new areas.

4.2. Control Strategy

The fischer model of the automatic planter is controlled by 5 motors. First, design the functional programs of each module on ROBO Pro, then load the designed programs into the intelligent control board, and use the intelligent control board to drive the motor to rotate through circuit transmission and then drive the corresponding components to operate to achieve the corresponding Function. Among them, the motors M1 and M2 drive the gears of the tree planter to rotate, as the driving force for moving forward, so that it can realize functions such as advancing and turning; the motor M3 realizes the rotation function of the tree planter, so that the tree planter can grasp the sapling to turn The designated direction; the motor M4 realizes

the lifting function of the tree planter, so that the tree planter can put the captured saplings into the dug hole; the motor M5 realizes the grab function of the tree planter, so that the tree planter can automatically Grab saplings and place saplings.

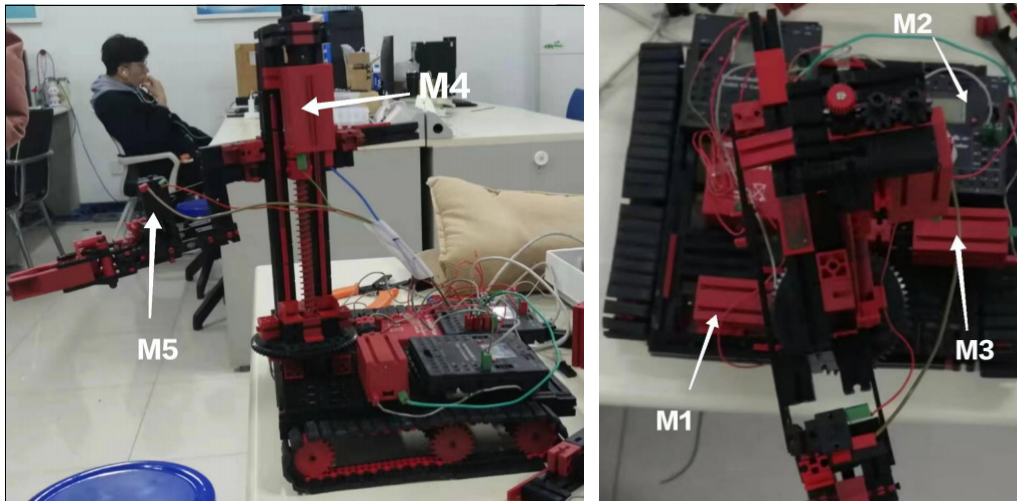


Fig 3. Motor layout

5. Conclusion

5.1. Innovations

1. The watering part uses the manipulator to automatically grab the film containing water and nutrients to supplement the water and nutrients of the seedlings.
2. The lifting part adopts worm drive, which has high transmission efficiency.
3. The sensor can intelligently identify the planting position and the temperature of the planting environment. Environmental parameters such as humidity.

5.2. Application Prospects

The automatic planting machine designed in this work can meet the needs of fast and efficient planting of seedlings. At the same time, it is cost-effective, has a wide range of applications, and has great development potential, so it has a high promotion and application value.

Most of the technologies used in automatic tree planting machines have already matured, and the equipment cost is not high. By integrating and utilizing a variety of equipment, the machine achieves multi-functional operations and greatly improves cost performance. Its application can save a lot of manpower and material resources, and the cost saved is greater than its own cost. There is no problem of high price and cannot be promoted on a large scale.

The automatic planting machine can solve many unsatisfactory aspects of planting seedlings in the wild, meet the needs of the country and workers to improve the efficiency of tree planting, and can be popularized and applied in various regions and terrains. At the same time, the application of the machine is not limited to planting trees, and it can also be used to plant crops similar to trees.

The development potential of this automatic tree planting machine is huge. It can not only develop the function of filling soil, but also develop functions such as watering and fertilizing, which is convenient for popularization and use in various situations.

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