Development of Rubber Fertilizer Machine Based on Visual Monitoring Technology

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Abstract: This article describes in detail the integration of a set of functional, agricultural machinery management agencies, service agencies, and users composed of three linkage management technology. The technology will be fixed-point positioning of agricultural tools, job trajectory, image acquisition, workload calculation, index detection, agricultural management and other functions close in the management of agricultural operations management environment, the macro-management of agricultural machinery, command and control scheduling, operational statistics, development decisions and individual management play a positive role in promoting. Test: Based on the visual monitoring technology, the rubber plant ditching and fertilizing combined operation machine can finish the joint operation of ditching, fertilizing and earthing at one time to achieve the purpose of avoiding the volatilization and loss of the limited water in the soil, thereby improving the fertilizer utilization rate, efficiency, and lowing cost. The machine is equipped with Dongfanghong 804 tractor, ditching depth up to 45cm, productivity 1.63hm^2/h, fuel consumption 3.4Kg/hm^2, fertilization uniformity 92.3%, the coverage rate is up to 96.9%.

1 INTRODUCTION

Natural rubber is an important strategic material. It is also one of the important cash crops, unique resources and pillar industries in the tropics in our country. It plays an important role in promoting the adjustment of agricultural structure in the hot zone and increasing farmers' income. In order to encourage the development of the natural rubber industry, the state started the seedling subsidy project of natural rubber seed. The Ministry of Agriculture also formulated and promulgated the "Regional Layout for the Advantages of Natural Rubber", clarifying the advantages of the three major natural rubber planting areas in Hainan, Yunnan and Guangdong. In recent years, it is actively rehabilitating the natural rubber plantation area with a planting area of more than 1800 mu and is one of the major One of the agricultural industries (ZHANG Yuan, 2016).

In the natural rubber production cycle need to rubber tree ditching, fertilization and other management operations to meet the needs of the growth of natural rubber. Fertilization is one of the important measures of rapid growth and high yield of rubber trees. Rubber trees that have already started to cut rubber need to be pressed and fertilized every year. After they stop cutting, they dig the green ditch (about 40cm in depth), press and spread the green, and then cover the soil. General fertilization per acre 250 ~ 300kg, during the cut cut, you need to top-dressing 750kg/hm^2. At present, the basic fertilization of rubber plantations use special organic fertilizer, the main fertilizer to powder, but also granular. The late 90s of last century, the Chinese Academy of Agricultural Sciences Institute of Agricultural Machinery and Xuwen County Qujie friendly farm tools factory cooperation on the rubber forest fertilizer machine, ditching and plow furrow plow was studied, developed a plastic ditching plow,

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fertilization Machine and pressed green plow were applied in small scale in Qujie Town, Xuwen County, Zhanjiang City, Guangdong Province (Figure 1), and achieved good economic and social benefits (ZHANG Yuan, 2016). However, there were still some problems that affected their further promotion application. Such as fertilization machine with two rows of operations, the rubber tree root damage more serious, only 20 ~ 30cm depth of ditching, reducing fertilizer efficiency, and fertilizer is not uniform. However, ditching and pressing are all single tasks with low efficiency and labor intensity, and there are many problems such as stealing, leakage and acceptance difficulties in the management process. Abroad on the plastic garden ditching, fertilizer and other management machinery research is rare, rare reports.

Figure 1: Double row fertilizers for rubber.

At the same time, as the economy continues to develop, the labor force continues to move to the cities (WANG Yeqin, 2016; Shi Yinyan, 2017; Li Hongjun, 2017). There are fewer and fewer workers willing to engage in rubber plantation management and the rubber plantation faces no one's control. Therefore, in order to reduce the labor intensity of rubber-field management workers, improve work efficiency, and strengthen the long-term monitoring and management of agricultural implements and agricultural materials to further reduce the cost of production management, develop a tractor supporting plasticized ditching and fertilizing combined operation machine , To replace the manual fertilization operation will be the inevitable trend of the future development of rubber plant ditching fertilization equipment.

2 DESIGN OF WHOLE STRUCTURE AND MONITORING SYSTEM OF FERTILIZER APPLICATION

2.1 Structural features

Based on the visual monitoring technology, the rubber plant ditching and fertilization combined operation machine is designed with the technical ideas of combination of functions, comprehensive performance and remote management. The standard three-point rear suspension mainly includes the frame, suspension system, ditching system, Transmission system, remote monitoring system, etc., among which the fertilizer device includes a worm gear transmission, a main transmission shaft, a fertilizer tank, a disc, a scraper, a fertilizer hopper, a transmission shaft, a drainage pipe and a connecting frame. The whole machine should be able to complete a one-time rubber plant ditching, fertilizing, earthwork and other joint operations and remote office management functions. Machine structure shown in Figure 2.

Figure 2: The main structure for rubber fertilizer machine.

Machine has the following characteristics:

First, the whole machine is designed according to the technical ideas of function combination, structure combination and performance comprehensiveness, and the matching power is moderate. Compared with the present management status, the machine can complete the ditching, fertilizing and earthworking together at one time to avoid the limited Volatilization and loss of moisture, thereby increasing fertilizer efficiency, high efficiency and low cost (ZHANG Yuan, 2017).

Second is the use of frame-type rack structure, open plow, soil cover and fertilization mechanism and the use of bolting connection with the rack bolting method, fertilizer institutions do not work, the dynamic match only to achieve trenching operations; such as the bolt disassembled after

matching other components , To meet the other machine rack use, to achieve the rack of versatility.

Third, the installation of fertilizer monitoring and alarm system, through four high-definition camera monitoring system, the driver can observe the status of fertilization and soil cultivation effect through the display at any time during the work process. The use of wireless voice alarm system real-time monitoring of fertilizer use, the alarm host number 1.2.3.4, when the fertilizer exhausted or can not be smooth fertilizer, will monitor the changes in the amount of fat will be no fat alarm number transmitted to the bee Alarm and alarm, cab staff through the alarm to monitor fertilizer operation or stop operations to ensure fertilization continuity, to solve the original drivers need to often look back and highly nervous, prone to fatigue and other issues (Zhu Yongren, 2017; Xie Jingfen, 2017; Yang Cheng, 2017).

2.2 working principle

As the tractor moves forward, the ditching plow begins to dig in and ditches. At the same time, the tractor power is transmitted to the power transmission shaft through the power output shaft, the universal transmission assembly is transmitted to the gearbox of the implement, the speed is reduced by a pair of bevel gears and the direction is changed, Until the worm gear decelerates and changes the direction of transmission to drive the disk in the fertilizer application device to rotate (Liu Jinbao, 2017; Wu Yujuan, 2017). As the mixed fertilizer passes through the conical hopper and falls onto the disk, the rotating disk moves the mixed fertilizer along the scraper and in the lateral direction Offset and along the edge of the disk down to the next fertilizer funnel, and then by the next fertilizer, so as to directly and quantitatively directly drop the ditch to open a good furrow ditch, at the same time, ditch plow side of the soil and continuous friction soil self-coverage Fertilizers to complete the ditching, fertilization and earthwork and other operations.

2.3 Monitoring system components and installation location

Remote monitoring system's core components include: mainframe, camera, digital display, GPS antenna, sensor groups and ancillary components. Which sensors are:

a.Power Sensor: measure real-time power of agricultural machinery

b.Speed sensor: measure the real-time speed of agricultural machinery

c.Acceleration sensor: obtain real-time acceleration of agricultural machinery, when the agricultural machinery complex operating conditions, the "turbulent forward" acceleration inevitably changes rapidly, the statistical variance is much larger than other operations

d.Image Sensor: Obtain agricultural work images, using image processing algorithms to extract relevant information.

e.plow body identification sensor: to obtain the type of agricultural machinery.

The specific core components of the installation location shown in Figure 3.

Figure 3: Remote monitoring system installation of the main parts.

3 FUNCTIONAL DESCRIPTION

Based on the visual monitoring technology, the rubber plant ditching and fertilization combined operation machine was tested in the field of rubber mechanization demonstration base of Guangdong Friendly Farm in Xuwen County, Zhanjiang, Guangdong Province. The field test was flat with an area of 0.67hm2 and rubber planting distance of 4.8-5.8m. Rubber density of 25 to 33 plants / mu. Dongfanghong 804 tractor matching machine, the main test results in Table 1:

Table 1: This caption has one line so it is centered.

index	result
Pure working hours productivity (hm^2/h)	1.63
Operating hours productivity (hm^2 / h)	1.21
Fuel consumption per unit area (kg / hm^2)	3.4
The amount of fertilizer per unit area(kg/ hm^2)	1206
Ditch depth(cm)	45
Ditch depth stability(%)	88.7
Fertilizer uniformity(%)	92.3
Fertilizer coverag(%)	96.9
Fertilizer breaking rate(%)	0

The whole machine is working properly, remote monitoring system better play a monitoring role, the operator of agricultural machinery with the corresponding guidance. Specific functions are as follows:

A.Automatic positioning of agricultural machinery

Description: Machine through the remote monitoring of agricultural machinery installed on the terminal equipment, the agricultural machinery of the geographical location, driving status, speed, direction and other data transmitted to the server, and then through the background data calibration system check, put these data to the platform and in The map depicts the real-time location of the farm machinery.

Application examples shown in Figure 4:

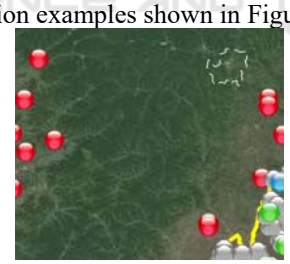

Figure 4: Agricultural machinery positioning map

B.Agricultural track query function

Description: The system will be agricultural positioning data to describe the formation of trajectory. The trajectory can be depicted at once so as to show the overall driving situation. The trajectory can also be simulated point-by-point and point-by-point.

Application examples shown in Figure 5:

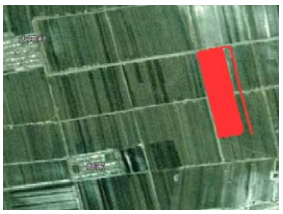

Figure 5: Agricultural machine trajectory query map

C.Image information collection function

Description: When the farm machinery is activated, the platform operator can take pictures in real time through the camera module of the remote monitoring equipment terminal. The image is transmitted to the image server by using the network of the device. If the signal is unstable, the image fails to be transmitted, and the device automatically stores the image, and sends the image to the image server when the signal is in a pause. The image server will store every image uploaded by each agricultural machine for customers to invoke viewing and other functions (job statistics, etc.) of the call.

Application examples shown in Figure 6:

Figure 6: Agricultural machinery image acquisition map

D.Agricultural machinery area calculation function

Description: The system analyzes the agricultural locomotive locating data, farm machinery image information and time-series statistical data, and calculates the farmwork area using the unit integration approximation algorithm. Its working principle is similar to measuring acres instrument, taking into account the disturbing factors of agricultural non-farming tracks (Song Xuefeng, 2017).

Application examples shown in Figure 7:

Figure 7: Agricultural machinery summary map

E.Agricultural operation indicators detection

Description: According to the multi-sensor on the remote monitoring equipment of agricultural machinery, the relevant data of agricultural machinery torque are uploaded to the server, and the system judges whether the agricultural machinery is in working status according to the above data and the occurrence time of the operation. Such as agricultural machinery ongoing operation will automatically open the image acquisition function, the system based on intelligent image recognition system, combined with soil conditions set by the calculation of indicators.

Application examples shown in Figure 8:

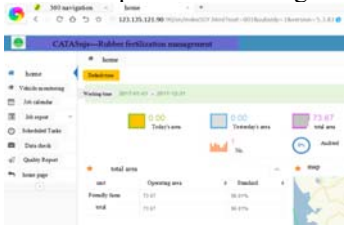

Figure 8: Agricultural machinery data analysis

4 CONCLUSIONS

a.The basic successful application of a set of functions set of agricultural machinery management agencies, service agencies, users composed of three linkage management technology, the positioning of the farm tools, job trajectory, image acquisition, workload calculation, index detection, agricultural management and other functions close Combining and serving the management environment of agricultural machinery, it plays a positive role in promoting the macro management, command and dispatch, operation statistics, development decision-making and individual management of agricultural machinery.

b.The rubber plantation ditching and fertilization combined operation machine based on visual monitoring technology basically fulfilled the requirement of synchronous dredging and fertilizing agronomy in rubber plantation field, in line with the development direction of modern agricultural machinery. Equipped with Dongfanghong 804 tractor, the machine can reach a depth of 45cm, a production rate of 1.63hm2 / h, an oil consumption of 3.4kg / hm2, a uniform fertilizer rate of 92.3% and a coverage rate of 96.9%, which can effectively increase production efficiency and reduce production costs.

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