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Design of Intelligent Monitoring and Early Warning System for Agarwood Pests and Diseases Based on AI Algorithm

Jing Lin, Junping Wu, Yongzhi Wu

Department of Mechanical and Electrical Information, Maoming Vocational and Technical College, Maoming, Guangdong 525000

Abstract: Agarwood is a kind of precious Chinese medicinal materials and spices, which has both medicinal and cultural and economic value. With large-scale artificial planting of agarwood in Dianbai District of Maoming and other areas, the problem of disease and insect pests has become increasingly serious, which has affected the industrial development. The problem of disease and insect pest control of Agarwood has become a prominent problem affecting the planting and industrial development of Agarwood. The traditional disease and insect control of Agarwood relies on artificial monitoring of disease and insect pests with low efficiency and lagging prevention and control. This paper uses AI visual recognition technology, Internet of Things technology and other technologies to study the disease and insect situation detection technology of intelligent insect situation ground monitoring station, and uses Internet of Things technology to send information to the intelligent analysis and early warning cloud platform of insect situation, analyze and predict the disease and insect situation, and push early warning information to farmers. The insect identification accuracy rate reaches 92%, so as to achieve early detection and early control of insect situation. It reduces the labor cost and the use of chemicals, and promotes the green and healthy development of agarwood planting industry.

Keywords: Agarwood planting; Pest control; Insect situation monitoring; Internet of Things

Agarwood, a Daphne family plant, is a precious Chinese herbal medicine and fragrance, which not only has antibacterial, anti-inflammatory, sedative and other effects, but also has cultural values such as collection and fragrance [1]. In recent years, the planting area of agarwood trees in Dianbai District of Maoming is more than 120, 000 mu, with more than 30 million agarwood seedlings growing annually, accounting for more than 80% of the national market. With the vigorous development of Agarwood industry, along with the large-scale planting of artificial pure forests such as Agarwood trees and white agarwood trees, the problem of diseases and insect pests such as the yellow field moth has become increasingly prominent, and the larvae of the yellow field moth (common name - hanging worm, leaf rolling worm) are explosive. The characteristics of binge eating [1], larvae will gather in large numbers and quickly eat the leaves, when the harm is serious, the harm rate between forests can reach more than 80%, the population density of a single plant from hundreds to thousands, within a few days can eat up the leaves and bark of the wood, resulting in the trees can not photosynthesis, poor growth, and death in serious cases. The problem of disease and pest control of agarwood has become a prominent problem affecting the planting and industrial development of Agarwood.

In recent years, with the development of agarwood planting industry, there have been certain studies on the prevention and control of Agarwood diseases and insect pests. In literature [2] Hong Renhui et al from Hainan Institute of Forestry Science analyzed which drugs were more effective in killing the larva of Agarwood, etc. In literature [3] Zhou Yakui et al from China Medical University used black light frequency vibration insecticides to lure and kill the nocturnal yellow borer, which likes light. In addition, the experimental situation was analyzed. Foreign David et al. also studied the killing of lepidopteran moths. The above studies and programs mainly focus on how to effectively kill pests. The collection of related pests is mainly artificial, and the common diseases of agarwood are also mainly artificial observation and discovery. Early detection and control of insect situation can not be achieved, and the analysis and prediction of disease and insect situation mainly rely on human experience, and the prevention and control has lag.

AI visual recognition technology, Internet of Things technology and other artificial intelligence information technology can be applied in the field of smart agriculture. This system is designed to integrate artificial intelligence technology and design an automatic monitoring and forecasting system for diseases and pests to improve the intelligent level of disease and pest control. According to the characteristics of diseases and pests of agarwood, the research on disease and pest detection technology of intelligent pest situation ground monitoring station is carried out. The Internet of Things technology is used to send information to the intelligent analysis and early warning cloud platform of insect situation, analyze and predict the situation of diseases and insects, and push early warning information to farmers, so as to achieve early detec-

tion and prevention of insect situation, reduce labor costs and the use of chemicals, promote the green and healthy development of agarwood planting industry, and meet the national strategy of leading agricultural science and technology innovation to support rural revitalization.

1. Design scheme of intelligent monitoring system for Agarwood pests and diseases based on AI algorithm

Aiming at the problems of low efficiency and lagging control of traditional artificial monitoring of agarwood pests and diseases. According to the characteristics of Agarwood diseases and pests, research and implementation of intelligent pest situation detection technology on the ground, the establishment of the Internet of Things data collection and transmission, cloud information platform, the realization of Agarwood disease and pest data information intelligent collection, statistics, analysis, management, early warning information release as one of the monitoring and early warning system, the realization of Agarwood plantations, The rapid and accurate prediction and early warning of insect situation and diseases, and the overall design of the intelligent detection and early warning system of Agarwood pests and diseases are shown in Figure 1.

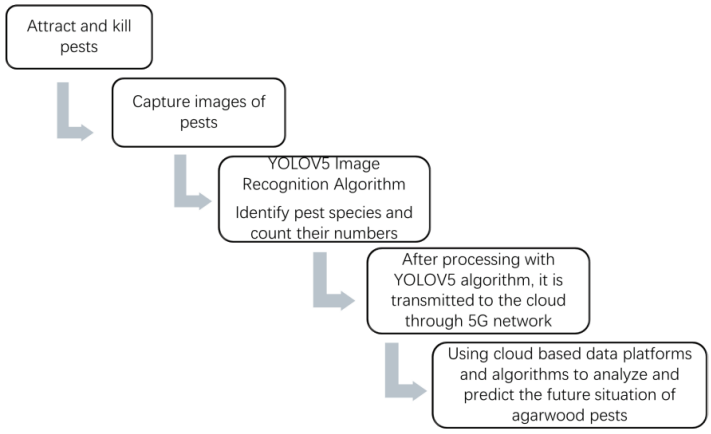

Figure 1. Overall design scheme of intelligent detection and early warning system for Agarwood pests and diseases

2. Research on key technologies of intelligent monitoring and early warning system for Agarwood pests and diseases

The intelligent monitoring system of Agarwood pests and diseases adopts a modular design. The main design contents include the design of a cage automatic pest killing device, the design of Agarwood pest image data acquisition device, the intelligent identification, classification and statistical design of Agarwood pests, and the intelligent analysis and prediction design of pests based on cloud data platform. The system platform of each module is built first, and then the module is detailed and improved. Inter-module coordination experiment, overall application test steps to carry out the system design, the key technology research of intelligent monitoring and early warning system of Agarwood pests and diseases is shown in Figure 2.

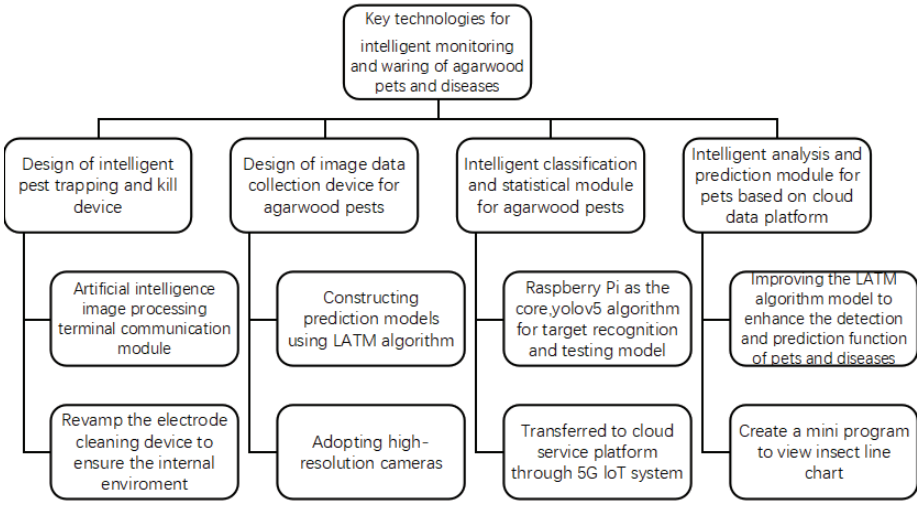

Figure 2. Research on key technologies of intelligent monitoring and early warning system for Agarwood pests and diseases

2.1 Design of intelligent pest trapping device

The design of intelligent pest trapping and killing device mainly includes intelligent trapping, killing and automatic clearing of flying insects. In view of the main agarwood pest, the adult worms of the Yellow field moth, most of which emerge at night, have the characteristics of phototaxis and night activity. Based on the frequency-vibration black light [4-5] to attract insects and kill insects, this design designs an automatic cleaning mechanism, which consists of insect collection and cleaning mechanism, camera and jetson nx artificial intelligence image processing terminal. Temperature and humidity, precipitation monitoring module, communication module. The automatic cleaning agency regularly clears the shooting area every day to ensure that new pests can be killed at any time and the internal environment of the system is updated to ensure the accuracy of pest image acquisition and recognition.

If the number of flying insects is too large, it may cause the internal space environment of the caged insect trap to become crowded or even escape, and in the shooting range of the camera, it may cause the camera to shoot unclear, thus affecting the judgment and processing of the later image data set. Therefore, the electrode cleaning device and insect body storage were modified and designed, and the development program of camera and intelligent processing terminal was added to ensure that the insect body stuck on the entrance and electrode fell into the shooting area, to ensure that new pests could be killed at any time and the internal environment of the system was updated.

2.2 Design of aloes pest image data acquisition device

The image data acquisition device of Agarwood pests designed in this paper aims to monitor and predict the species, quantity and development trend of Agarwood pests, and statistically analyze and predict the development trend of Agarwood pests by collecting adult insects (moths) at the emergence stage. Existing image data of Agarwood pests need to be collected for analysis and prediction. The device can take images of dead agarwood pests. The device requires efficient, fast, high-resolution and accurate images of pests inside the trap. The higher the resolution of the camera module, the more accurate the data obtained, which is crucial for image recognition and future early warning.

Combined with the growth rules and cycles of spawning, larvae, adults, pupae and emergence of major pests such as the Yellow Bosoma, combined with temperature and precipitation data, a disease and insect pest prediction model of Agarwood was constructed based on the LSTM (long short-term memory Network) algorithm. LSTM is a special Recurrent Neural Network. RNN) algorithm can effectively store long-term information, avoiding the problem of information loss when traditional RNN processes long sequence data, and has strong robustness [6]. The experimental results show that the LATM algorithm is used to effectively improve the sequences of plant diseases and insect pests forecasting precision.

2.3 Intelligent identification, classification and statistics module of Agarwood pests

Intelligent identification and statistical pests with raspberry pie as the core module design, trained model using the algorithm of YOLOv5 deployment on raspberry pie [7], the camera target identification with the image data of the statistics, and the results after recognition by 5 g wireless communication module is sent to the cloud server, so that we can save server part of the operating pressure, reduce the cost. At the same time, the YOLOv5 algorithm program running on the Raspberry PI can identify and count the image data set efficiently and accurately, and output the results after recognition and statistics.

With Raspberry PI as the core, the YOLOV5 algorithm model was used to train the identification model of the Yellow field moth. Cameras and artificial intelligence terminals were designed on the insect cage, which could shoot the hunted pests regularly, and artificial intelligence algorithms were used to classify and count the number of pests. Key pictures and statistical results were sent to the cloud service platform through the 5G Internet of Things system.

2.4 Intelligent pest analysis and prediction module based on cloud data platform

The intelligent pest trapping and collection terminal combines the early experience basis of aloes disease and pest species, pest characteristics, occurrence rules, and relationship with temperature and precipitation, and adopts the improved LSTM artificial intelligence algorithm model to establish the monitoring and forecasting function of aloes disease and pest with long-term evolution, which can solve the problem of the low degree of automation in monitoring and reporting the occurrence of aloes disease and pest, and the lagging time of prevention and control. The large use of pesticides has seriously affected the development of agarwood tea industry.

The cloud data platform based on 5G network runs the monitoring and prediction algorithm module program of Agarwood pests, which can process data from edge devices in real time and efficiently. The output results of the intelligent pest identification and statistics algorithm program running on the Raspberry PI are sent to the cloud server, and data fusion and prediction are carried out with the help of big data and artificial intelligence algorithms and technologies. Cloud computing is responsible for the intelligent prediction model training of agarwood pests in different time and different space and other conditions. The cloud data platform is responsible for updating the collected image data set and the processing results to the web page or APP page in real time, further cleaning and processing of the data, ex-

changing data and control signals with 5G base stations, and providing data support for cloud computing. The cloud data platform collects valuable data from multiple 5G base stations' pest image data sets for large-scale storage and analysis, modeling the development trend of agarwood pests, and timely warning.

Figure 3. Test results of larvae (spider worm)

3. Conclusion

This paper designs an intelligent monitoring and early warning system for Agarwood diseases and pests based on AI algorithm, and realizes a monitoring and early warning system for Agarwood diseases and pests that integrates intelligent data collection, statistics, analysis and early warning information. It improves the automation level of Agarwood diseases and pests occurrence detection and report, and the insect identification accuracy rate reaches 92%, thus reducing the harm of diseases and pests to Agarwood industry. Reduce labor costs and the use of chemicals, improve the yield and quality of agarwood, and promote the green and healthy development of Agarwood planting industry. The system can also be applied to the disease and pest monitoring and early warning of other Chinese medicinal materials and crops, and contribute to the sustainable development of agricultural industry.

References

[1] Chen Yu, Zhou Guoying, Chen Guode, et al. Comparative analysis of plant metabolites of different resistance to Botrytis chinensis [J]. Chinese Journal of Environmental Entomology, 2019, 46 (4): 988-997. (in Chinese)

[2] Hong Renhui, Yin Jifeng, Chen Yu, et al. Research progress of the Yellow Field Borer, an important pest of white wood [J]. Tropical Forestry, 2019, 47:66-68

[3] Zhou Yakui, Qiao Hailey, Zhan Qingqing, et al. Occurrence and control of major diseases and insect pests in Hainan white wood [J]. Chinese Journal of Modern Chinese Medicine, 2017, 19 (8): 1102-1105.

[4] Qiao Haili, Xu Changqing, Xu Rong, et al. Study on the effect of insecticidal lamp combined with attractor plant on the prevention and control of Borer Borer [J].Chinese Journal of Traditional Chinese Medicine, 2016, 41 (11): 2025-2029.

[5] QIAO Haili, Xu Changqing, Zhou Yakui, et al. Application of insecticidal lamp in the prevention and control of Borella borella [J]. Chinese Materia Medica, 2017, 40 (9): 2026-2029.

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