Research and Development of Insect Situation Data Intelligent Cloud Platform Using Geographic Information System

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Abstract. With the changes in climate, pest varieties and resistance to pesticides, pests have shown frequent and recurring characteristics, making the supply of major agricultural products and food security facing severe challenges. The key to preventing and controlling pests is to correctly identify the pests and then apply the correct drugs and doses. This paper uses cloud computing, artificial intelligence and big data technology to build a cloud platform for identification and early warning of pest situation. Users use smartphones as terminals to accurately identify crop pests and form a complete crop pest distribution database, which is conducive to grasping the rules of pest occurrence. It is conducive to targeted pest control and is conducive to improving the efficiency of pesticide application control, thereby increasing crop yields.

1. Introduction
According to relevant statistics, there are currently more than 100 pests that threaten my country's agricultural and forestry crops and may cause major disasters. Taking the more common rice planthoppers and rice leaf snails as examples, they not only directly eat crops themselves, but also indirectly spread major epidemic diseases due to large-scale migration [1]; with the global warming climate trend, pests throughout the year The number of reproductive generations has also increased significantly, the time of northward migration is earlier, and the time of southward migration is delayed, and the geographical range of damage has shown the characteristics of continuous expansion [2]. In addition, for pests that have occurred, in the process of prevention and control, due to the mismatch of the pesticide species or the insufficient concentration of the pesticide, it is easy to cause the pest species to mutate, the pest resistance gradually increases, and the pesticide control efficiency gradually weakens [4]. The prevention and control of pests caused difficulties.

Most of the current insect information collection depends on the collection of agricultural practitioners. Most agricultural practitioners have insufficient ability to identify a wide range of pests, or the identification of pests is correct but the practitioners lack of professional knowledge and it is difficult to correctly match the corresponding drug types. The phenomenon of large-scale and blind application is very serious.

Through the use of cloud computing, artificial intelligence and big data technology, we build a cloud platform for pest identification, analysis and early warning, which is conducive to reducing the impact of pests on crops on a large scale.
2. Research and Development of GIS-based Insect Situation Data Management Cloud Platform

2.1. Cloud Platform architecture

The architecture of this system is shown in Figure 1, which is divided into two parts: one is the insect situation cloud platform, and the other is the end user.

![Figure 1. The architecture of this system](image)

The insect situation cloud platform has the functions of processing, identifying, and archiving insect pictures, as well as the functions of insect information analysis, display, and prediction, and can automatically crawl relevant insect information from the Internet and accurately push relevant information to end users.

End users refer to smartphone users who have installed a designated APP. End users collect insect images, obtain insect recognition results from the cloud platform, and obtain relevant insect information, such as insect information, prevention and control recommendations, pesticide manufacturer recommendations, and other information.

The main technical route adopted by this system is shown in Figure 2:

![Figure 2. Technology Roadmap](image)

For insect recognition, this system adopts the target detection technology based on deep learning, and deploys different target detection frameworks in the terminal and server. The process of terminal identification of insects is shown in Figure 3.
2.2. Construction of insect situation analysis cloud platform based on GIS and intelligent system

(1) Insect image processing and recognition module

Based on the insect image collected by Android Application of mobile phone, the time stamp and longitude and latitude information are recorded at the same time. After the original image is stored by the server, it is processed, adjusted and segmented for recognition, and the recognition results are saved in the cloud. There are some unrecognized insect images, which are submitted for artificial recognition, and the recognition results are returned in time. At the same time, the morphological characteristics, living habits and control methods of the identified insects are returned.

(2) Construction of GIS platform for insect distribution

The platform integrates the pest database, geographic distribution display, historical pest situation, real-time and historical meteorological situation. The platform has statistical function, which can trace all kinds of pest situation and assist users to carry out pest control.

(3) PEST analysis and prediction system

The time and space distribution of insect situation is automatically generated, the comprehensive safety prevention and control technology is established, and the machine learning technology is used to analyze and predict the insect situation. In this system, the regression algorithm is used to predict the pest situation in each region. There are many regression algorithms, such as classical linear regression, ridge regression, Lasso regression and so on. In recent years, the effect of regression algorithm based on tree model is usually better than that of classical regression algorithm, such as xgboost [12] regression and lightgbm [13] regression, and the effect is significantly improved. This system uses the above two regression algorithms to predict insect situation. Figure 4 shows the effect of the system in a certain area.

Figure 3. The process of insect identification

Figure 4. Forecast effect of insect situation in a certain area
(4) Insect information recommendation system

This system uses user portrait technology, based on the powerful big data ability, according to the end user’s account number, generate user portrait, accurate screening, personalized push message, recommend relevant insect information.

After obtaining the static data, we need to carry out factor and cluster analysis on the population. Different purposes are classified according to different static data, including user name, collected data, longitude and latitude, landing time, etc. After background analysis, users are tagged, such as "rice farmers", "corn farmers", "cotton farmers", etc. The system can accurately push the basic information of related pests, Prevention and control suggestions and pesticide business information.

3. Conclusion

Users can identify more than 70 kinds of common agricultural and forestry insects through Android Application of the system platform, expect to identify more than 200 kinds of insects, and the recognition accuracy is more than 85%, and the recognition accuracy of some insects is more than 90%. The response speed is within 2 seconds from taking photos to getting results. According to the identified pests, automatically introduce the identification of insect species, habits, morphology, distribution, prevention and control points. Through the promotion and application of the platform, the harm of pests to agricultural production can be greatly reduced, and the use of pesticides can be reduced by more than 20%. On the one hand, the production cost of agricultural products can be reduced, and on the other hand, the environmental pollution caused by the production process of agricultural products can be reduced.

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