

소나무 재선충의 정보관리 어플리케이션

김준연

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The Information Management Application of *Bursaphelenchus xylophilus*

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[요 약]

본 연구에서는 우리나라의 대표수종 소나무의 치명적인 해충인 소나무재선충 피해목의 확산을 조기에 차단하고 산림수목에 대한 지속적인 관리를 위하여 소나무재선충 피해수목 신고 어플리케이션을 개발하였다. 어플리케이션은 다음과 같이 3개 핵심항목을 중심으로 개발되었다. 첫째, 소나무재선충에 대한 정보제공, 둘째, 피해목의 자가진단, 셋째, 수목안전지도 등으로 구성하였다. 향후 본 어플리케이션의 활성화를 위해서 실제로 어플리케이션을 사용하는 이용자들의 적극적인 참여와 산림청 어플리케이션과의 통합개발이 이뤄진다면 보다 많은 활용이 가능할 것이다.

[Abstract]

In this study, a smartphone application for reporting trees infected with pine wilt disease was developed to prevent the spread of the disease by the disease-carrying pests/insects, which is most damning to the country's pine trees, South Korea's representative tree species, and to ensure the sustained maintenance of the country's forest trees. Such application for handling information on the infected pine trees has three key components, as shown below. (1) Explanation of the pine wilt disease pests/insects, (2) Image capture of the infected pine tree, and transmission of its GPS location, (3) Inquiry on the neighboring area infected with pine wilt disease. It is possible to promptly provide the spatial information of the areas infected with pine wilt disease by developing a dedicated application for reporting trees infected with the disease based on GPS information. If users participate actively in the application and integration with the forest service application is to be realized, the application would be more actively utilized.

색인어 : 정보관리, 어플리케이션, 소나무, 숲병충해, 소나무재선충

Key word : : Information management, Application, Pine tree, Forest disease, *Bursaphelenchus xylophilus*

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I . Introduction

While plenty of plants are being attacked by disease-carrying insects/pests, all pine trees infected with pine wilt disease usually die within only three months after the initial infection, inflicting a most fearsome disease impact on the infected pine trees compared to any other forest disease and insect/pest known to exist on Earth.

Fearing the grave seriousness of pine wilt disease as well as the potential damages it can inflict on indigenous pine trees, the South Korean government has been doing its best to stop the infiltration of the country's forests by pine wilt disease, taking numerous preventive actions, including its designation as a prohibited pest/insect in the Plant Protection Act. Despite such efforts, however, the government has failed to stop the infiltration of the country's forests by such pests/insects amid the increasing internationalization and opening of borders. Ever since the first report of infection in Busan in 1988, the disease has spread from the pine trees in the country to the fir trees, spruce, some species of *Larix olgensis*, and Himalaya cedar. Worse, the scale of the damage is growing as the disease spreads to other forests.

A brief look at the present state of the utilization of IT information in the forest sector shows that IT services are constructed and utilized well at the level of providing information on the forest utilization. However, the utilization of IT information is not up to the sufficient level when seen from the perspective of forest tree maintenance. Accordingly, there is a limit to understanding the scale and status of the damage inflicted on the forest when pests occur.

Therefore, in this study, a smartphone application for reporting trees infected with pine wilt disease was developed to prevent the spread of the disease by the disease-carrying pests/insects, which is most damning to the country's pine trees, South Korea's representative tree species, and to ensure the sustained maintenance of the country's forest trees. Towards this end, the establishment of a tree pest/insect information management system based on GPS (global positioning system) and LBS (location-based services) was proposed to enable the monitoring of the pine wilt disease, which is currently spreading across the country, and to facilitate a prompt response to such phenomenon.

II . Pine Wilt Disease Pest/Insect

2-1 Key characteristics of the pine wilt disease pests/insects

Pine wilt disease is caused by *Bursaphelenchus xylophilus*,

which looks like a 1-mm-long thread. As 100% of the pine trees inflected with the disease are expected to wither to death in the end, the disease is inflicting massive damage on the local forests. Pine wilt pests/insects cannot move and thus spread to the neighboring pine tree forests by piggybacking on *M. alternatus* or *M. saltuarius*, species known as mediating pests/insects in the country, inflicting massive damages.

2-2 Pine wilt disease outbreak

The tree species that are frequently infected with pine wilt disease are reported to include some trees belonging to the pine tree genus as well as *Abies holopylla*, *Pinus parviflora*, *Lalix leptolepis*, and *Picea abies*. In Japan and South Korea, for instance, the seriousness and extent of the damage caused by the infection vary depending on the trees. In the pine tree genus, Japanese black pine, Japanese red pine, Korean white pine, and *P. luchensis* are known to be receptive to the disease-carrying pests/insects whereas Loblolly pine and slash pine are known to be resistive to them. In general, the pine trees in the Eurasian continent are receptive to the pine wilt disease pests/insects whereas those in the American continent are resistive to them. As for the pine trees, Japanese black pine and Korean white pine, which are frequently found in South Korea, are receptive to the pine wilt disease pests/insects, making extraordinary caution and prevention measures necessary.

2-3 Symptoms of pine wilt disease

Pine trees will wither to death once their leaves turn into another color and then droop. Once the old leaves droop and wither, the damage gets even worse as the new leaves are also dragged down and die. As 100% of the pine trees infected with pine wilt disease will eventually wither to death, the disease inflicts massive damage on the local forests. Such discoloration and withering of the pine tree leaves progress quickly, and the entire tree eventually turns stunning reddish brown. The leaves that have turned reddish brown will fall to the ground before long.

The infected trees species are the pine trees, particularly the Korean white pines. Once healthy pine trees get infected with pine wilt disease, the trees will have difficulty ingesting and circulating water and nutrients, thereby making their leaves droop and wither. The symptoms manifest fast when the pine wilt pests/insects infiltrate a massive amount of pine trees in summer, when the temperature is high. The discoloration of the withered leaves becomes evident about three weeks after the initial infection, and all the leaves will turn brown after about

one month. The infected trees then die. If the infection time by the pine wilt disease pest/insect is delayed or if only a small amount of such pests/insects infiltrate a pine tree, the symptoms will start to appear at a later time. That is, the infected tree will wither to death in the following year, or in some cases, only some branches will die.



그림 1. 재선충에 피해입은 수목(일본)
Figure 1. Scattered trees of *Pinus thunbergii* in Japan, killed by *B. xylophilus*

III. Location-based Services

The LBS system consists of services that detect the location of persons or automobiles using LTD (location detection technology) or GPS (global positioning system) with an added application, which works based on the identified location data. The LBS system is currently being used in diverse areas and is increasingly being highlighted due to the accelerated dissemination of smartphones since recent years.

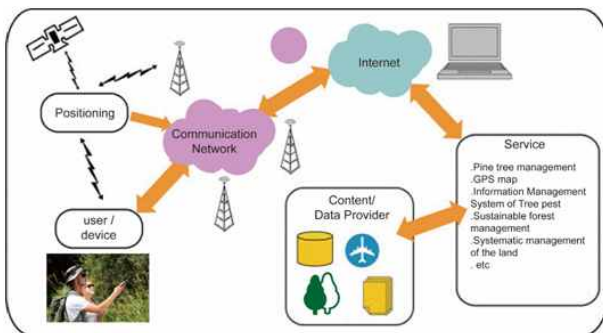


그림 2. 어플리케이션 네트워크 다이어그램
Figure 2. The application Network diagram

GPS provides location information by periodically emitting location-related signals via a web of satellites with synchronized time codes. GPS sensors simultaneously receive signals from more than four different satellites, and the satellite signals

received as such facilitate the calculation of the present location and velocity. In particular, the information provided by GPS enables the pinpointing of the accurate location within an error of a few meters in an outdoor environment.

In general, the LBS system consists of a suite of technologies, including the wireless location measurement technology working through the mobile communication network, the server technology for the LBS system and related contents, and other application technologies. The LBS system acquires location data using GPS, which works through a web of satellites

IV. Development of an Application for Managing the Information on Trees Damaged by Pine Wilt Disease Pests/Insects

4.1 Development environment

In this study, a mobile application was developed to support the prompt handling and continuous management of trees infected with pine wilt disease every year. Such application for handling information on the infected pine trees has three key components, as shown below.

1) Explanation of the pine wilt disease pests/insects

Provides general information on and a self-diagnosis kit for infected trees

2) Image capture of the infected pine tree, and transmission of its GPS location

Simple image capture displaying the capture time and GPS location of the captured image; automatically transmitted to the server of the Korea Forestry Service main control center

If GPS reception is not available given the condition of the forest area, the map showing the confirmed path of the user shall be enlarged, and then the rough current location of the user shall be inputted manually to generate location information. Such manually inputted location information shall again be automatically transmitted to the server of the Korea Forestry Service main control center when GPS reception is renewed.

3) Inquiry on the neighboring area infected with pine wilt disease

The key development items for the tree pest/insect information management application can be divided into

pine wilt disease pest/insect information, tree list, tree safety map information, damage self-diagnosis kit, and configuration, as shown in Table 1.

표 1. 수목의 병충해/질병 정보 관리 응용 프로그램 개발
Table. 1. Development items for the tree pest/insect information management application

Criteria	Contents
1 Information on pine wilt disease	General information on the pine wilt disease pests/insects
2 Infection self-diagnosis kit	- Tree type selection - Extent of damage in the leaves and bark - Damage status by pine wilt disease
3 Tree list	Information on the list of key trees that can be infected by the pine wilt disease pests/insects
4 Tree safety map information	Information on the current location - Information on the areas reported to have been infected with pine tree disease - Information on disease prevention
5 Configuration	- Registration of contact - Remote control - Help - Notification settings

The system, which is designed for general use, draws a map of damages based on the prompt reporting of the areas infected by tree pests/insects, and allows the checking of the damage distribution by year, area, pest/insect type, and tree type. It also enables the scientific and comprehensive management of infected pine trees by allowing multiple spatial screenings of the damaged areas and the early detection of the areas infected with the disease as well as by supporting the prompt and accurate prediction and preemptive observation of, and disease prevention works on, the areas with a high risk of infection.

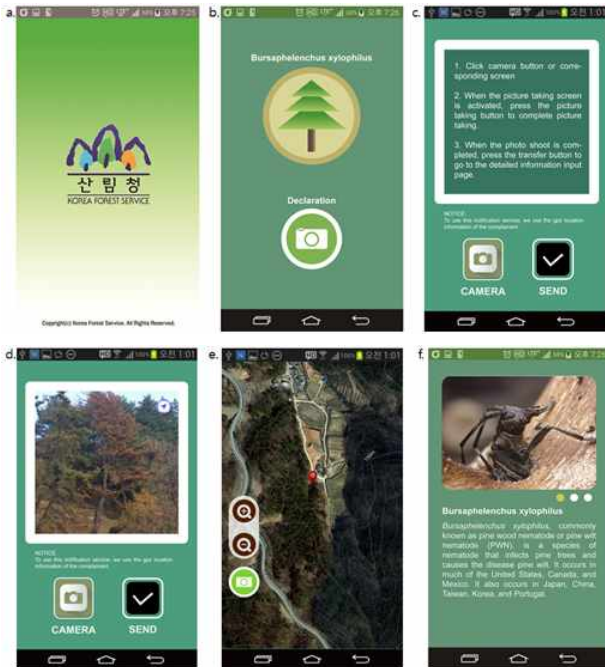


그림 3. 어플리케이션 화면구성: A. 초기화면, B. 홈, C. 카메라 화면, D. 사진화면, E. 지도표시화면, F. 소나무재선충 설명화면

Figure 3. Screen configuration of the application : A. Intro, B. Home, C. View of Camera, D. View of Photo shoot, E. View of the map, F. View of Explanation about Bursaphelenchus xylophilus

V. Conclusions and Implication

It is possible to promptly provide the spatial information of the areas infected with pine wilt disease by developing a dedicated application for reporting trees infected with the disease based on GPS information. The information acquired as such can be actively used for future disease prevention planning and for establishing a disease prevention strategy. Such prompt reporting via the reporting app will help minimize the damage from the infection and will enable the efficient management of the information on forests. In addition, if users participate actively in the application and integration with the forest service application is to be realized, the application would be more actively utilized.

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