Intelligent detection device of pavement disease based on image recognition technology

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Abstract. In recent years, the continuous progress and development of artificial intelligence technology, especially the technology represented by deep learning and image recognition, have made great breakthroughs, and put forward new methods for road surface disease detection. In this paper, image recognition technology is applied to the direction of high-level pavement detection, and an intelligent disease detection robot is developed based on GPS navigation technology, which realizes the integration process of pavement disease from detection to location.

1. Introduction  
Road diseases [1] seriously affect road traffic safety and service life, so accurate detection of road diseases is of great significance. Traditional road disease detection method basically relies on artificial close contact detection, which has the problems of low efficiency, large error and high risk [2]. In this paper, a pavement disease detection device based on image recognition technology is proposed to solve the problems of low accuracy, poor positioning and high risk of pavement disease detection.

2. Design process  
Based on image recognition technology and GPS positioning technology, our team developed an intelligent robot for high-grade road disease detection, as shown in figure 1. The project completes the weight of the depth model for road disease detection in the workstation, and imports the detection model into the core controller of the robot through the machine vision port of OpenCV [3]. Then, the GPS point mark of the detection route is carried out by the ground station named software mission planner [4], and the voyage is input into the control terminal equipment. The robot conducts inspection work according to the set route, uses the camera to record the video during the cruise, and recognizes the image of the video frame, and returns the road disease image to the server. Finally, the disease information and the robot’s driving situation are visible in the display terminal to facilitate subsequent road maintenance work. Figure 2 shows the workflow of the device.
3. Device Design Core

3.1 MobileNet-SSD algorithm

In order to make the robot achieve the effect of real-time detection in the working process, the author selects the MobileNet-SSD [5] depth model. As an efficient target detection method, MobileNet-SSD has been applied to real-time detection of road traffic conditions [6], real-time detection of mobile targets [7] and identification of power equipment [8], but it has not been applied to road disease detection. Figure 3 below is the network structure of MobileNet-SSD. MobileNet-SSD mainly uses deep separable convolution, and divides the standard convolution kernel into deep convolution and point convolution (figure 4), so as to reduce the complexity of convolution operation. The width multiplier and resolution multiplier are introduced in the model training process to reduce the size of input and output channels and feature map.
3.2 Route Planning of Detection Device

In the process of robot movement, in order to ensure its high positioning accuracy, the team used the dual GPS positioning method based on differential positioning [9]. The differential correction is calculated through the measurement of GPS satellite signal by the robot core controller to improve the positioning accuracy of the robot. The team adopted the robot motion controller based on ATMEGA2560 chip, connected it with the host computer ground station mission planner through wireless data transmission, and planned the path on the ground station. Finally, the route data were written into the control terminal to realize the autonomous movement of the robot.

3.3 Disease display terminal

The device is equipped with a disease display terminal to receive road disease detection results (Figure 5), so as to realize human-computer interaction. Connect the robot to the display terminal by building a data storage server. The disease display terminal can access the server to obtain data by using the OKHTTP framework with multiple threads, and uses the RecyclerView framework to optimize the deficiencies in the Android own control ListView.
Figure 5. Road disease information display terminal. (a) Main interface window. (b) Disease Information Database Window. (c) Disease Information Window.

4. conclusion
In this paper, an intelligent detection device for road diseases based on image recognition technology is proposed, which can output video frames containing road diseases, and complete the automatic inspection of roads with the help of GPS positioning technology. In this study, Mobilenet-SSD was used as the target detector, and the model was trained and tested with four types of targets (cracks, pits, gravel, leaves). Mobilenet-SSD recognizes 65 frames per second, and develops road disease display software based on Android operating system to provide service for subsequent maintenance work. The main contributions of this paper are as follows. 1) The advanced target detector is customized to make the airport pavement inspection system real-time; 2) An automatic inspection system framework based on video frames is proposed.

In the next stage, Mobilenet-SSD needs to be improved. The ideal result is that Mobilenet-SSD has higher recognition accuracy. In addition, in order to realize the comprehensive evaluation process of airport pavement apparent disease and FOD, the author will use the installation depth camera to collect the three-dimensional information of the target and develop the corresponding risk assessment algorithm.

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