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Machine Vision Monitoring of Mountain Flood Disaster and Landslide Warning Based on K210

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Abstract: *With the accelerated development of industrialization, the global climate is constantly deteriorating, and the impact of natural disasters on humanity is becoming increasingly severe. In order to effectively distinguish different degrees of mountain flood disasters and landslides, and analyze the severity of mountain landslides that occur during mountain flood outbreaks, this paper proposes a machine vision based method for monitoring and early warning analysis of mountain disasters, combining image processing and pattern recognition technology. This article designs a mountain flood and landslide monitoring system based on machine vision to achieve the effectiveness of project content, and has a mobile end where each module can be executed in collaboration.*

Keywords: *Computer vision, Monitoring system, Mobile terminal, YOLOV5 algorithm, Rainstorm and flood detection*

1. Introduction

With the acceleration of industrialization, the global climate is constantly deteriorating, and the impact of natural disasters on humanity is becoming increasingly severe[1]. In recent years, flash floods and landslides have become common types of natural disasters in China, especially in regions such as Gansu, Guangxi, Sichuan, Guizhou, Zhejiang, etc. The human and economic losses caused by mountain disasters such as flash floods and landslides are enormous every year[2]. According to the basic situation of natural disasters in China released by the National Emergency Management Department, there were 5659 mountain disasters such as landslides, collapses, and mudslides in 2022 alone, with 33.853 million people affected, 171 deaths or missing, and a direct economic loss of 128.9 billion yuan.

In this era of big data and the Internet of Things, efforts to improve urban flood control and disaster reduction, as well as the construction of mountain disaster warning, should shift from traditional work models to intelligent ones. Therefore, the development of a high-performance and intelligent early warning and monitoring device for mountain flood disasters and landslides has become an urgent need at present.

In order to effectively distinguish different degrees of mountain flood disasters and landslides, and analyze the severity of mountain landslides that occur during mountain flood outbreaks, this paper proposes a machine vision based method for monitoring and early warning analysis of mountain disasters, combining image processing and pattern recognition technology. This article aims to construct a K210 based machine vision early warning and monitoring device for mountain flood disasters and landslides, to achieve real-time detection, recognition, and early warning of mountain disasters, improve monitoring efficiency and accuracy of mountain disasters, achieve early detection of mountain disasters, and improve geological disaster prevention and control capabilities.

2. Program

The first step of the project is to establish a disaster feature analysis model, simulate the construction of mountain disaster monitoring stations, and collect real-time mountain geographic information through camera modules, high-precision sensors, etc; The collected image information relies on the K210 development board [3], and the YOLOV5 algorithm [4-5] is used to fuse image recognition to analyze and recognize mountain disaster activity scenes , as shown in Figure 1.

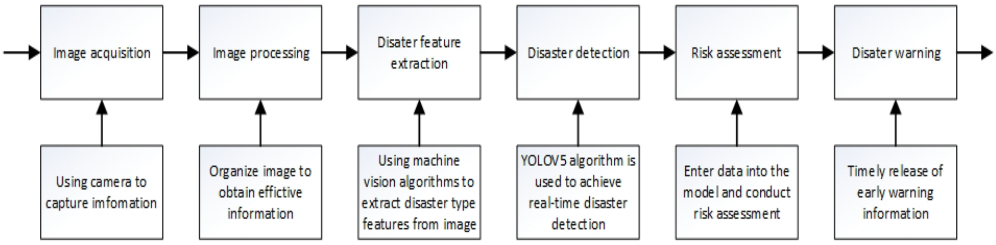

Figure 1: Monitoring System Execution Block Diagram

2.1 Image recognition

The RISC-V processor architecture carried by K210 has three main features: audio-visual integration, autonomous IP core, and powerful programmable ability. It supports multimodal recognition of machine vision and machine hearing, and has the core requirements of a dual core 64 bit CPU, which can flexibly adapt to edge side scenes. The chip is equipped with SRAM and offline database, which can complete data processing and local storage on the device, and complete the recognition and processing of images collected during flash floods and landslides.

2.2 Machine Vision Fusion

In terms of machine vision fusion, this project adopts the YOLOV5 algorithm. The YOLOV5 algorithm has been improved and improved for nearly a decade since its establishment, and is widely used in the field of machine monitoring. It has good processing power and reliability, and is used together with the system to construct algorithms for identifying flash floods and landslides.

2.3 Cloud data transmission

In addition to the K210 development board, this project also incorporates another STM32F4 development board to learn algorithms for local offline models. By learning model algorithms, conduct risk analysis on the collected information and evaluate the level of risk. All collected information is sent through the ESP8266 network [6], as shown in Figure 2, achieving cloud data synchronization. Data transmission has broken away from distance limitations, and even environmental information in remote areas can be transmitted in real-time to monitoring centers thousands of miles away, better helping decision-makers make decisions.

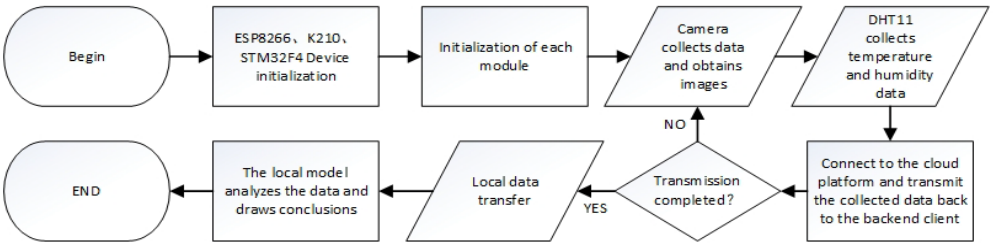

Figure 2: Cloud Data Upload Flow Chart

3. Modeling

3.1 Training platform

The model training is shown in Figure 3, and the intelligent recognition effect of machine images is shown in Figure 4. Different color boxes represent different scenes recognized by the trained machine.

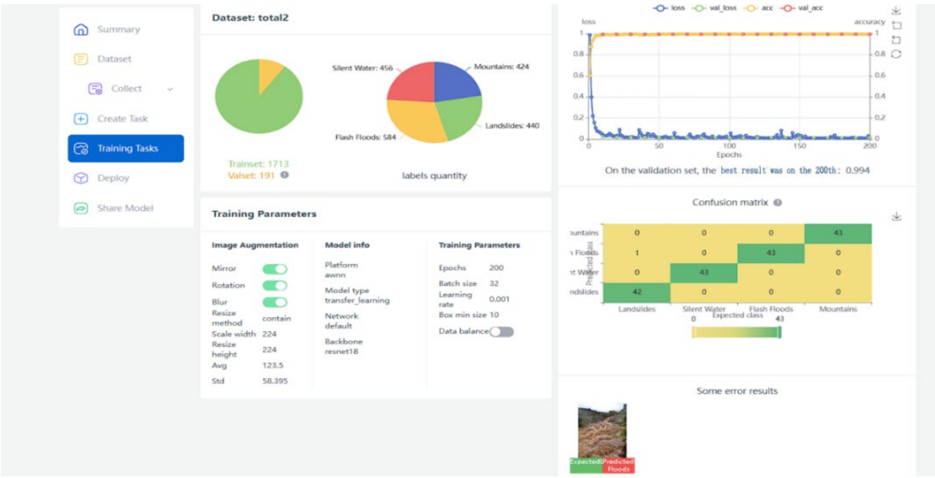

Figure 3: Model Training

Figure 4: Image recognition

3.2 Design and Construction of Hardware Systems

The hardware part uses STM32F4 as the main control chip, and integrates temperature and humidity modules, camera modules, ESP8266 modules, etc.

3.3 Cloud data processing and application design

The webpage interface is shown in Figure 5. We have constructed the main framework for visualizing the project webpage. By combining JAVA WEB technology, MYSQL database, and Alibaba Cloud server [7], we have achieved the functions of transmitting information, storing information, and visualizing data to the cloud through STM32.

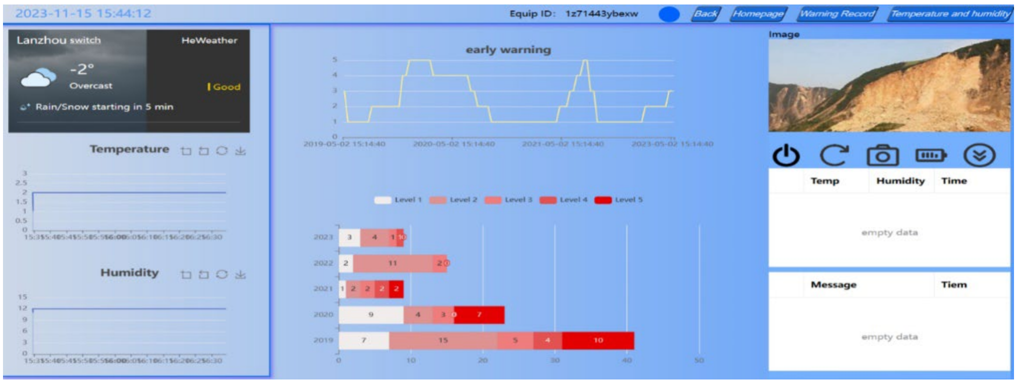

Figure 5: Design of the Web

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3.4 Building local prediction models

Sichuan, Yunnan, Guizhou, Gansu, Qinghai, Guangxi, Zhejiang, Fujian and other places are prone to flash floods and landslides in China.Topographic and geological conditions, meteorological conditions, vegetation cover and human activities are the main factors influencing the occurrence of flash floods and landslides in these areas.We use the official statistical platform as well as the hardware of the system to collect data and model and analyze the data variables.

Referring to the previous scholars' research on the early warning system of flash floods and landslides in these areas. (1) Research on dynamic early warning model of flash flood disaster based on rainfall numerical forecast [8]. (2) Flash flood disaster monitoring and early warning system based on watershed model method [9]. (3) Research and application of flash flood warning and forecasting technology [10].At the same time, combined with the methods of machine Xi and data mining, an early warning model is established.The model is mainly applied to the critical rainfall method and logistic regression algorithm.Generally, the critical rainfall method is mainly based on the analysis of the rainfall of historical flash floods, combined with the formation conditions, and through regression, statistics, hydrological models and other methods to determine the critical rainfall of flash floods. Through the weather forecast and the actual precipitation situation, based on the critical rainfall, the probability of flash flood occurrence is determined according to the forecast model.The logistic regression model is used to predict the probability of flood disasters and landslides, which scales the data according to the characteristics in the historical data, such as temperature, humidity, rainfall, etc., as well as the label of the landslide event (whether a landslide has occurred), gives a risk assessment, and achieves the effect of early warning and monitoring.

4. Discussion

This project adopts the Kanzhi K210 camera module, which mainly features audio-visual integration, independent IP core, and strong programmable ability. It supports multimodal recognition functions for machine vision and machine hearing, making it cheaper and more powerful in computing compared to many products on the market. The monitoring and early warning system does not require manual operation. The device has a compact structure, convenient installation, convenient maintenance, and adopts flexible power supply methods. In terms of power supply, high-performance lithium batteries can be chosen, or solar energy can be used to ensure continuous operation of the equipment. Real time monitoring can be achieved in the vast majority of regions. The main body of the project adopts the model algorithm combining machine vision, combined with machine learning and neural network developed in that era, through machine learning to identify and warn mountain disasters, and using edge computing to make K210 have the graphics processing ability that traditional single chip computers do not have, and effectively complete the task of target recognition.

5. Conclusion

This paper constructs a K210 based machine vision early warning and monitoring device for mountain flood and landslide disasters. The STM32F4 microcontroller is used to achieve real-time detection, recognition, and early warning of mountain disasters. Disaster risk analysis and judgment can be completed without manual analysis, saving labor costs, and timely disaster warning. This device uses wireless modules to transmit data, ensuring complete data transmission, reducing the possibility of information loss, accelerating disaster warning, and reducing the likelihood of related personnel being killed. The hardware structure design of this project is relatively reasonable, suitable for mountainous and rural environments, and has strong environmental adaptability and stability. The image recognition technology of YOLOV5 algorithm is combined with the Kanzhi K210 camera module to achieve the goal of 1+1>2, greatly improving efficiency and making more accurate decisions.

A user-friendly monitoring interface has been deployed on the mobile end, with functions such as real-time information processing, disaster analysis, disaster risk assessment, and real-time release, improving the quality of early warning information release and ensuring timeliness. The software and hardware of the system can be updated and upgraded to further strengthen the prevention ability of mountain flood disasters and landslides.

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