Preliminary Research on Optimization Strategy of Geological Disaster Prevention System Based on Mobile Terminal Applications

ZHANG Yuxin[1,a], LU Yudong[1,b], PAN Yihua[1,c], LI Xin[1,d], YANG Yahui[1,e], ZHANG Rong[1,f], LU Sufen[1,g] and JIA Songmin[1,h]

[1]School of Environmental Science and Engineering, Chang'an University, 126, Yanta Road, Xi'an 710054, Shaan Xi, China

[a]52816880@qq.com, [b]luyudongphd@163.com, [c]710649328@qq.com, [d]471289383@qq.com, [e]1005252778@qq.com, [f]942243480@qq.com, [g]469748743@qq.com, [h]740584259@qq.com

Keywords: geological disaster prevention; information ecosystem; mobile terminal application

Abstract. Through geological hazard survey, the network of group monitoring and preventing in the surveyed area is built and perfected, the purpose of which is to improve local inhabitant consciousness on the geological disaster prevention and mitigation, and to insure the monitoring, early warning and geological disaster prevention messages deliver rapidly and accurately through the network. The article analyzes the information flow of the geological disaster prevention system, and mainly discusses the organizational structure of the network of group monitoring and preventing, and the running mechanism of monitoring and early warning system based on the structure. The analysis found it necessary to increase the efficiency of the information flow in the system. And then, the optimizing the environment of information technology was taken to consideration to solve the problem. Thus this article analyzes the characteristics of the mobile terminal applications, the results of which show that its characteristics are suitable for optimization of the geological hazard prevention system. Therefore, the wireless network technology is introduced to the system, and a concept model is explored based on APP client of mobile terminal.

Introduction

The development and detriment of mountain hazards is not only relevant to the geology, landforms, hydrology and meteorological environment, but also has a close relationship with human economic activity and abilities to prevent natural disaster[1]. In the process of preventing disaster, applying the results of the disaster survey and risk assessment can improve the ability to fight natural disaster, and thus alleviate some losses. Despite the disaster assessment technique at home and abroad has developed rapidly in recent years, disaster evaluation is not wildly applied in mitigation activities due to lack of adequate understanding of social role, coupled with incomplete methods and narrow application[2]. Therefore, It's imperative to improve the acquaintance to its function in the process of developing geologic hazard survey and disaster risk assessment. In the same time, making full use of non-formal education to improve the regional consciousness of preventing and fighting disaster in the geological and hydrologic risk area is very crucial[3]. During the detailed investigation of geological disasters, the monitoring and prevention mass network has been built and improved according to relevant regulations, which aims at improving the consciousness of preventing and fighting disaster and passing information of monitoring and early warning prevention through monitoring and prevention mass network quickly and accurately, which helps

local people to reduce the loss of life and property to a great extent. The monitoring and warning system of this network which is based on the cooperation of more function sectors at the county level is component of three network levels, where information flow manifests a chain structure, and it is possible to improve the efficiency.

Information ecosystem of geological disaster prevention

Geologic hazard usually refers to losses of people's life and property caused by geologic effect[4] and also is a sort of geological phenomenon which gives rise to the loss to human society. In order to lower the loss of life and wealth caused by geologic hazard, geologists research the regular pattern of geologic hazard so that predict the space-time sphere during the occurrence of geologic hazard, and try their utmost acquire great security blanket for the project and people in dangerous areas.

Geologic disaster prevention belong to the category of government information eco-chain[5, 6], and is also one of the government information eco-chain subsystems, and the author refers to as information ecosystem of geological disaster prevention, which consists of information, information subject and information environment[7]. Information includes phenomenon and regular pattern of geologic hazard, for instance, spatio-temporal evolution and development of many objective natural factors, such as hydrology and geological environment, weather events, and social factors, human engineering activities and so on. in the area. Information subjects refer to geologists who undertake the outdoor investigation and inspection, and individuals, groups or organizations who find lurking peril of disaster and victims. They are the information providers, in the meantime, they can be information transfer, after successfully predicting and preventing geologic hazards, they become information consumers. Information environment mainly consists of organization, policy, culture, personnel technique and infrastructure and so on, among which, IT provides great power for acquiring information resources and information transfer[8], and information policy and law environment of geologic hazard endow with mandatory and authority for more scientific and reasonable counter system[9], which also stipulates the information norm, information system and behavior of information subjects.

Transfer process of information of geological disaster prevention and control. Coordinating and controlling the relationship between the human activity with geological environment are the fundamental ways in case of geologic hazard. Info-ecosystem of geologic hazard as shown in Fig. 1.

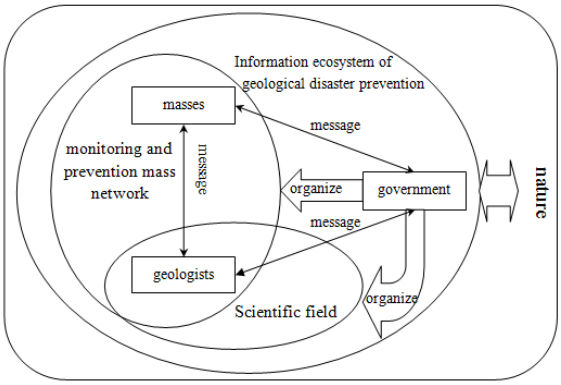

Fig. 1 Information ecosystem of geological disaster prevention

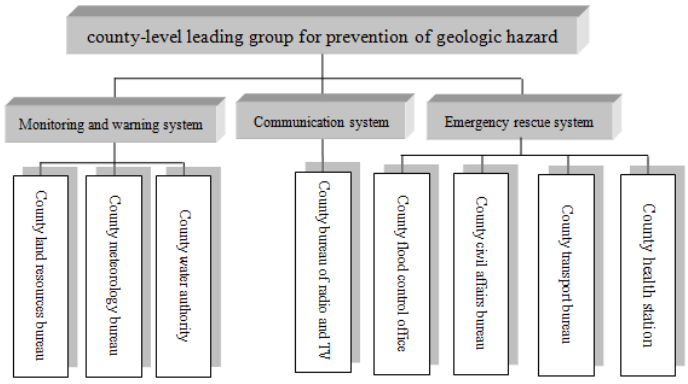

Fig. 2 Organization chart of county-level leading group for prevention of geologic hazard

In the info-ecosystem of geologic hazard, monitoring and prevention mass network, which constitutes a subsystem of the system, a crucial part of the info-ecosystem, is required to be created and better by the standard of geological disaster prevention and control in the legal environment.

The following is about analysis of information transfer process of the monitoring and prevention mass network. This network ensures subject-the local people acquire information, grasp the knowledge of disaster prevention and mitigation and comprehend the formation conditions of geologic hazard in order to advance and improve the information flow efficiency in the system, in the meantime, it can quickly and accurately transmit the information about monitoring and prevention to the downstream information via the network, to a great extent, which conduces to achieve the goal of this system and mitigating the loss of local geologic hazard. the status quo of the system operation is as follows:

Information flow manifests a chain structure between information subjects and passes many information ecology layer[8]. Under the construction and operation programs of monitoring and prevention system, it is proposed to establish the county-level leading group for the prevention of geologic hazard and monitoring and warning system which is the concerned of the county administrative department ,the organization structure shown in Fig. 2 and Fig. 3 respectively. System design mobilizes fully many relevant sectors to jointly prevent and govern geologic hazard.

The form of information processing and conversion of subject is traditional. In the county-level monitoring and warning system of geologic hazard, leading group for the prevention of geologic hazard from the township regularly submit the dynamic information from stricken areas; and investigate the trends and condition of stricken areas. Regularly reported period is once a week in the rainy season, once a month during the dry season, and these information will be submitted timely in some special circumstance. Those in charge in the monitoring and warning points are responsible for the collection, record, compile and regular reporting of raw data. Dynastic data in stricken areas is regularly reported by surveillance personnel, and then submitted by the county-level leading group, because different departments pay attention to different information and the decomposition and processing of data is reorganized by some personnel who are from different level. The data transfer mode of chain information layers and decomposition of data become more and more artificial, which delay information flow to some extent.

A range of information subject is to be extended. The space covered by monitoring and warning network is still to be expanded, and currently is limited to local residents, hence the scope of monitoring and prevention only involves stricken areas that threat villages. However, a considerable part of the disaster point places in the road on both sides, which gives rise to potential threat to the vehicles on-road. Local residents during the flood period may have a stronger awareness of prevention, but for tourists from the outdoors, it is necessary to understand the condition of the road where happens disaster frequently and enhance the awareness of safety. Currently the monitoring and prevention mass network cannot fully cover the disaster points.

To optimize the monitoring and prevention system, we can improve the IT environment in order to reduce the nodes of chain structure, then optimize the information ecology layer, and improve the sharing efficiency of information, finally enhance the function of information subject and optimize whole the info-ecosystem of` geologic hazard. IT environment may involve the network transmission, access control and database mining and other techniques[7]. Optimizing the IT environment of the subsystem at first should solve information container[10]. To the 21st century, information users have realized the audience evolution[11, 12], the huge and dispersive heterogeneous information gives audiences multi-channel and multi-faceted experience under the three-dimensional information environment, which attributes to the results of IT development. In the meantime, wireless Internet makes mobile terminal become an crucial carrier of information. In the aspect of optimizing info-ecosystem of geologic hazard, we can make use of mobile terminal upgrade information container, which can elevate the efficiency of information flow.

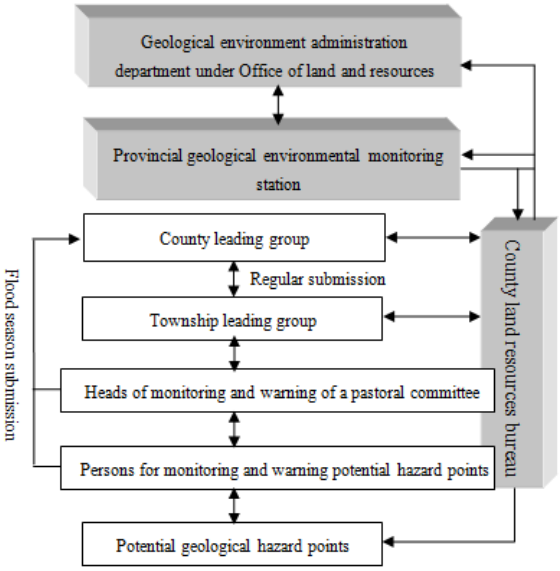

Fig. 3 System structure diagram of geological disaster monitoring and warning

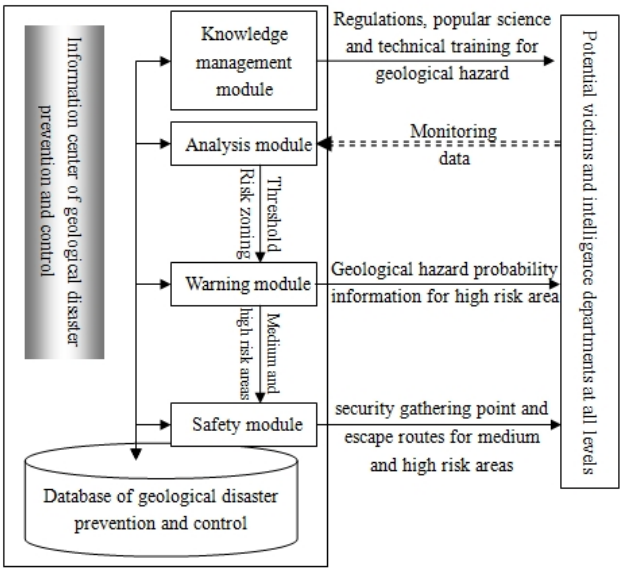

Fig. 4 Conceptual model of geological disaster prevention

Conceptual model of geological disaster prevention system based on mobile terminal

Character of mobile terminal applications. With the popularity of smart phones and mobile devices such as the iPad, people become accustomed to surf the Internet through the APP client. Currently, many major domestic electricity providers own their APP clients, which has developed successfully in the commercial field. The success bring a crucial enlightenment for monitoring and warning of geologic hazard.

The function of APP is custom-developed, hence it involved very wide range of applications[13]. APP can integrate LBS and QR technologies such as location-based and rapid responses services. LBS is Location Based Service, Which aims at to acquiring the location information of terminal-user(geologic coordinates or geodetic coordinates) through the radio communication from telecommunication network operators (such as GSM network, CDMA network) or external positioning means(such as GPS). And it also provide users with a value-added service with the support of GIS(Geologic Information System) platform. QR(Quick Response) is a rapid response and also a term of supply chain management. This rapid service is necessary for sharing the monitoring and warning information of geologic hazard.

Based on the portable, interactive features, APP can share and disseminate in order to achieve fissile growth through the way of microblog, SNS(Social Network Software) and other means. Such fissile growth is also more in need of rapidly achieve broad coverage of prevention common sense and information about geologic hazard.

These characteristics of APP clients apply to the field warning and prevention of geologic hazard, we can solve the information flow problems to great degree, as long as design and develop its functions which can meet needs.

Conceptual model of geological disaster prevention system. In summary, based on the information flow problem during the geologic hazard period and characteristics of mobile terminal application, we can design the conceptual model of geologic hazard analysis and warning system, which is shown in Fig. 4. Its key technical support service is still the result of distribution law of geologic hazard and warning threshold, which advances the information flow of whole the system, what's more, the channel of information flow draws support from mobile terminal devices.

① This system which integrates with LBS technology determines the personnel who enters the high incidence of geologic hazard and push security warning through the way of message; it's pointed to groups of tourists during flood period goes into geologic hazard areas and local residents. Its content aims at showing them Wechat attention account or Microblog platform of geologic hazard security.

② It can transmit the relevant knowledge about prevention and mitigation of geologic hazard through making full use of Knowledge Management Module of Wechat or Microblog platform server, in detail, it mainly involves relevant laws and regulations, prevention science knowledge of geologic hazard, formation phenomenon of various hazard, general emergency preparedness, relief and simple monitoring methods of the disaster geologic hazard and weather-related phenomena, which can encourage and help the mass to join the monitoring network supported by the platform; and further provide interface of disaster monitoring and early warning information.

③ Organizing the monitoring information that the mass may send to into system analysis module. Take rainfall for instance, as a major geologic hazard trigger factor, it is more difficult to monitor, because the characteristic of precipitation will take place a big change with the spatial and topographical change, it is more difficult to estimate accurately the wide-bound precipitation intensity with limited monitoring data from hydrological stations and meteorological stations, what's more, the professional monitoring equipment is only used in disaster points, therefore, it's very imperative to observe the rainfall by local residents, which is not only crucial to rainfall empirical threshold value which is used to explore the possibility of occurrence of geologic hazard, but also is important to evaluate and analyze the risk of geologic hazard, and implement the measure about mitigating the risk[14]. After grasping the basic monitoring knowledge about geologic hazard and have acquaintance with relevant functions about APP client, when the mass encounter the persistent or intense rainfall, they can timely send the information about rainfall intensity; when the mass witness or on the spot by themselves, they can take photos and then send the data to analysis module of information platform through APP client.

④ Analysis module analyzes the data about historical calamity and monitoring data which needs persistent update, and calculates risk threshold value and risk zoning.

⑤ Through comparing the monitoring data and threshold value, early warning module can calculate the spatial-temporal probability in high-risk area, and push the result to APP client through the way of message and Wechat platform when surpasses the threshold value.

⑥ Safety module mainly deals with the geographic information in high-risk areas, and get the security gathering point and escape routes which the mass from different areas can consult; in the meantime, it can push this route to APP client in the graphic or animated form through the way of message or Wechat platform.

Summary

As to geologic hazard, it requires accurate, timely, and comprehensive coverage from survey, finding, research information transfer of monitoring and warning, pointed to it, group monitoring and prevention mass network plays a crucial role. It built on multi-level organization, and

information transmission also shows chain structure; what's more, combined with the traditional form of data processing, which delay the transfer efficiency of geologic hazard; however, the network is only limited to partial towns, and coverage is so narrow, hence, current network cannot satisfied the needs accurately timely and comprehensively.

To apply the theory of information ecosystem, and then analyze, finally find the key to improve the transfer efficiency of information. In current society, with the rapid development of information technology, information users have realized the evolution of information audiences, which belong to the result of acceleration of information transfer, and problems to be solved.

In order to bring in information technology and improve the information environment, this article mainly explore the application environment types and characteristics of intelligent mobile terminal applying APP client, put forward the conceptual model of geologic hazard prevention system, and exert fully many characteristics of location-based services, quick response, ready portability, interactivity and sociality, in the meantime, and enhance the application performance and timeliness of investigation results about geologic hazard. This model is only limited to primary stage, which confronts incomplete function and needs to be improved, we expect that it will implement in the future.

Acknowledgements

This work was financially supported by Qinghai basic research for application (2014-ZJ-706) and Geological survey project (12120113009000).

References

[1] Flash Floods, Debris Flow, Landslides and disaster prevention (Scienc Press, Beijing 1994).

[2] Z. Liang, Z. Yecheng and L. Yuanhua: Theory and practice of geological disaster assessment (Geological Publishing House, Beijing 1998).

[3] E.A. Goto and J.d.L. Picanco. Place-Conscious Education for Disaster Prevention in Risk-Prone Ares of Sao Paulo. In: Sassa K, Canuti P, Yin Y, editors. World Landslide Forum 3. Beijing, China: Springer International Publishing Switzerland (2014). 745-749.

[4] Regulations on the Prevention of Geological Disasters. In: State council C, editor. 394. Beijing(2003).

[5] Z. Yunhe: submitted to Information Research (2013)

[6] Z. Haitao, X. Xiaojun, L. Yuanchi and S. Tuo: submitted to Information Science (2013)

[7] H. gang and Q. Zheng: submitted to Information Studies: Theory & Application (2007)

[8] Y. Xiaoxi. Research on the Optimization of Supply Chain Based on the Information Ecology Theory [D]. Wuhan: Central China Normal University 2009.

[9] X. Fei and Y. Fei: submitted to Science & Technology Information (2012)

[10] X. Huichang: submitted to Lantai World (2011)

[11] Z. Jinfan. Information·Law·Audience—Research on the Optimization of Public Information Ecological Environment [D]. Fuzhou: Fujian Normal University 2008.

[12] Z. Jinfan: submitted to Journal of library and information sciences in agriculture (2011)

[13] B. Fling: Mobile Design and Development (O' Reilly Media, Inc., Sebastopol 2009).

[14] Y. Malakar. Community-Based Rainfall Observation for Landslide Monitoring in Western Nepal. In: Sassa K, Canuti P, Yin Y, editors. World Landslide Forum 3. Beijing, China: Springer International Publishing Switzerland (2014). 757-763.

