Updating information on water resources drought using volunteered geographic information

Abstract

Introduction

In recent decades, rapid climate changes in the Middle East have led to the rapid growth of drought phenomenon. Given the recent observations and surveys in the countries of the region, the rate of evaporation of surface water has increased. In addition, water consumption has increased dramatically in recent decades due to various causes, including industrial and agricultural development and population growth. Apart from the natural causes, the lack of proper management and planning of water resources is one of the main reasons for drought occurrence in the country. It's obvious that every program needs reliable and updated information to help planners make decisions. Therefore, information on the volume changes and the amount of water is of great importance in the management of the limited water resources. This information is usually obtained using conventional methods of remote sensing, surveying and photogrammetry which require significant amount of time and money. On the other hand, obtaining information from people is very beneficial due to the high speed, low cost of preparation and high volume of shared information. Volunteered Geographic Information provides an environment for the acquisition of spatial information from ordinary and expert people. Recently, many researches have been carried out on geography, natural resources and geosciences in relation to the voluntary applications of spatial information in crisis management, and it has been proved that these data are suitable for managing long-term and short-term crises. Regarding the water management in particular, researches have been carried out on collecting water pollution information through sharing the location and the type of water pollution. The issue of drought in water resources has not been taken into consideration in this category of investigations. Another category of the researches is about the type of architecture used to obtain popular information from the volunteered spatial information, while the quality of this information has been ignored. In another category of the researches, users identify and report the rate of changes in water resources using remote sensing and aerial images but, this method is indirect and does not share information instantaneously and directly.

Materials and methods

The aim of this paper is to design and develop a Volunteered Geographic Information system for receiving and updating drought information on natural water resources. To do so, users send the information on water volume and its changes as well as the location, to the drought information spatial database. The case study of this paper is the water resources of the rivers and lakes of the Tashk_Bakhtegan_Maharloubasin. Tashk_Bakhtegan_Maharlou is a basin region in the province of Fars in Iran, and the reason for choosing this basin as a case study is the abundance and diversity of water resources in the area. A Web-based mobile application has been developed to receive the popular information of water resources. Users can share information based on the level of access. This level of access is determined based on the level of users' expertise and occupation relative to water sciences. In order to implement this system, a client - server architecture was employed, in which SQL Server was used as the updating and managing system of the spatial database, ArcGIS Server as a spatial server, WCF Service to receive thematic information, JSON as the format of exchanging data and Android as the client's development language.

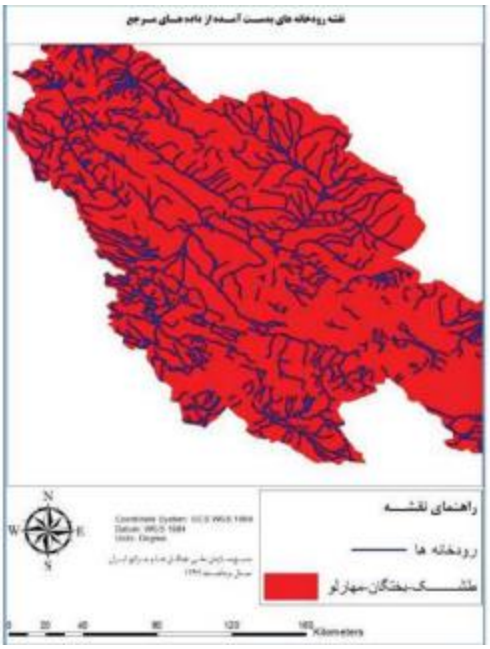
The sample developed application User Interface are illustrated in the following Figure:

In this Figure, the level of water and the severity of water flow of a river was reported using combo boxes and text boxes.

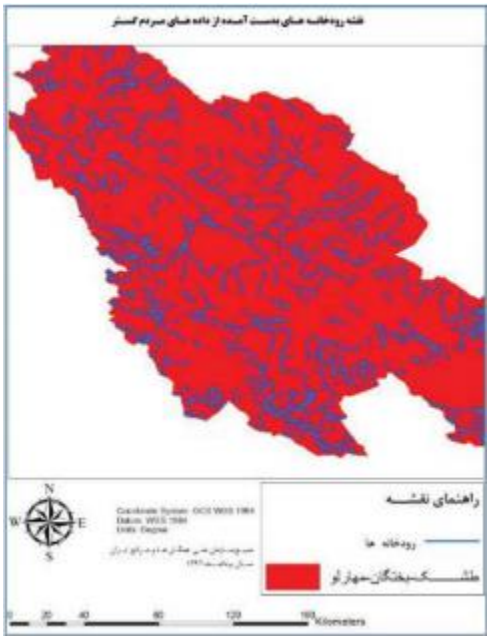
Discussion and results

In order to evaluate this system, the spatial accuracy, descriptive accuracy and the integrity of the Volunteered Geographic Information were measured. After the evaluation, a spatial accuracy of 12.5 meters, a descriptive accuracy of 67%, and the integrity of 75% were obtained. Moreover, 80% of the Volunteered Geographic Information had an area of more than 1 Hectares, representing the interest of the users in sharing lakes with wider areas. Meanwhile, 65% of the Volunteered Geographic Information has a density of 27 lines per Hectare, indicating that people are willing to share rivers with denser branches.

The following Figure illustrates the reference map of water line features in the studied basin. Red color indicates the basin area and blue color shows water features.



The following Figure shows the VGI map of the basin for line features. Red color indicates the basin area and blue color shows water features.



Conclusion

Since the data was collected by smartphones' GPS, the value of spatial accuracy was predictable. Descriptive accuracy obtained is relatively low due to the ambiguity in the naming of received data. The high integrity indicates the capability of the system in updating drought spatial database over a short period of time. Therefore, it seems that the Volunteered Geographic Information on drought is generally acceptable for completing the water resources database and for the management and making decisions on the planning of conserving water resources in a short time with low cost.