WebVOS-A WebGIS Application for Volunteer Observation Ships

Honghai Zhu\textsuperscript{1,a}, YuYu\textsuperscript{2,b,*}, Shibo Chu\textsuperscript{3,c}

\textsuperscript{1}Institute of Oceanographic Instrumentation, Qilu University of Technology Miaoling Road 37 Qingdao, China 86-13854214398
\textsuperscript{2}National Engineering and Technological Research Center of Marine Monitoring Equipment Miaoling Road 37 Qingdao, China 86-15864749133
\textsuperscript{3}Shandong Provincial Key Laboratory of Marine monitoring instrument equipment technology Miaoling Road 37 Qingdao, China 86-13863953223
\textsuperscript{a}hyyqyb@163.com, \textsuperscript{b}rainertop@126.com, \textsuperscript{c}chushibo@126.com

ABSTRACT This paper presents a WebGIS-based application WebVOS which supports management of volunteer observation ships. The design and architecture of WebVOS is fully described, which covers ship equipment, server and client. The server provides ship info, tile map, observation data collection and trajectory data services. Client is responsible for data requesting from server data services and display rendering. WebVOS supports commonly operations of volunteer observation ship management, which increases its availability. A real project is carried on to validate the application and result shows its availability.

1. INTRODUCTION
Volunteer observation ships (VOS) plays an important part in global marine weather observation. It is mainly used to collect various marine hydro meteorological data on the ship navigation route to obtain ocean observation data on the near shore, middle and far ocean. The development of volunteer observation ship can make up for the shortcomings of real-time monitoring capabilities in the far ocean. The valuable information obtained is useful for marine weather forecasting, marine scientific research, marine transportation safety, fishery production safety, aquaculture safety, port terminal safety, national defense military construction [1-3], etc. In [4], a ship monitoring system based on WebGIS is described, in which two critical problems- integrated reading of three format of maps and dynamical display of 3000 ships on the maps is solved. In [5], a navigation aids information distribution system based on network GIS was developed by WEB GIS technique and GeoBeans. In [6], by supporting of Flex and WebGIS technology, a marine meteorological information forecasting and distribution platform has been constructed. In [4], a B/S mode WebGIS application is designed and implemented based on JSP technology. So far as we known, there is no dedicated WebGIS system for volunteer observation ships.

Rest of this paper is organized as follows. The framework architecture of WebVOS is presented. Then, three kernel components of WebVOS are described. After that, an application example is presented. Finally, conclusion and the future work are given.
2. WEBVOS SYSTEM ARCHITECTURE
As demonstrated in Fig. 1, the VOS system is based on B/S mode. In the server, services are exported using JSON format. In the client, VOS information is updated by a timer which periodically requests data from the server. The stateless mode between server and client keeps the overall system architecture neat and simply. The kernel services provided by the server are ship info service, tile map service, observation data collection service and trajectory data service. Ship info service provides basic information about the ship, including current position, name and identification, etc. Tile map service serves maps as tiles by splitting the map up into a pyramid of images at multiple zoom levels. Observation data collection service gathers observation data from ship equipment via satellite, mobile and microwave communication. Trajectory data service focuses on ship trajectory management, which provides multi-level spatial indexing and spatial querying. The client uses tile map service to do map rendering. Ship info service is used for ship position and key information display in the client. The client uses trajectory data service for ship trajectory display based on map rendering.

Figure 1. WebVOS system architecture.

3. SHIP EQUIPMENT DESIGN
Ship equipment is installed on the ship which contains a host and other peripherals. As demonstrated in Fig. 2, the host is composed of monitor, keyboard, memory, work indicator, alarm buzzer, AC&DC power supply and acquisition processing system. There are mainly two kinds of peripherals: communication equipment and sensors. Those sensors are responsible for gathering hydro meteorological parameters on the ship navigation routes. Acquisition processing system gathers observation data from sensors. Then, observation data are further processed and delivered to ground station through satellite, mobile communications, etc.

Figure 2. Ship equipment architecture.
4. SERVER DESIGN
The function of the server can be divided into two parts (see Fig.3): web services and data collection. First, data collection server gets observation data from communication equipment and stores those data into database. Then those observation data are presented by web services which are supported by web server. Clusters of web server and database are used to ensure the availability under high concurrency.

![Server Architecture Diagram](image)

Figure 3. Server architecture.

5. CLIENT DESIGN
A JavaScript open source frame OpenLayer is used for basic map operations. Periodic update is maintained by a timer. In the timer expiring events, data are requested from the server via Json web services and rendered to form map rendering, ship rendering and trajectory rendering (see Fig.4).

![Client Architecture Diagram](image)

Figure 4. Client architecture.

6. APPLICATION EXAMPLE
In order to validate the Web-GIS application, it has been used in volunteer boat marine observation and management (See Fig. 5 and Fig.6), which is dedicatedly designed for monitoring seawater temperature and salt, wind speed and direction, tidal, rainfall in the ship sailing routes.
7. CONCLUSION
In WebVOS, the designs and architecture for volunteer observation ship management application are provided. Yet, those components with Java and JavaScript runtime are proved to reliable, stable and easy to use. In future, development and refinement on those designs will be continued and an open source project will be founded.
ACKNOWLEDGMENTS
This work is supported by the National Key R&D Program of China under the Grant 2017YFC1405600, National Science Foundation for Young Scientists of China under the Grant 41706101, Qingdao Applied Fundamental Research Project under the Grant 18-2-2-71-jch, Qingdao City Southern District Science and Technology Development Fund under the Grant 2016-2-012-ZH.

REFERENCES
[1] Owen T, Brewer M, Redmond K, et al. Advances in Web-Based, Near Real-Time Climate Data Ingest For NOAA's Cooperative Volunteer Observation Network[J]. Agu Fall Meeting Abstracts, 2006.
[2] Zhou Y, Jiang Y, Zhu H, et al. Application of WXT520 in volunteer ship observation system[J]. Meteorological Hydrological & Marine Instruments, 2011.
[3] Crimmins T M, Crimmins M A, Gerst K L, et al. USA National Phenology Network’s volunteer-contributed observations yield predictive models of phenological transitions[J]. Plos One, 2017, 12(8):e0182919.
[4] Nan X Z, Tao L H. Design of ship monitoring system based on WebGIS[C]// The, International Conference on Information Sciences and Interaction Sciences. IEEE, 2010:6-8.
[5] Peng G J, Zhang X G, Xiang L. Construction of Navigation Aids WEB GIS Information System[J]. Ship & Ocean Engineering, 2007.
[6] Wang H, Sun Y, Min J I, et al. Research of Qingdao Marine Meteorological Services Platform Based on WebGIS and Flex[J]. Geomatics World, 2015.