Adaptation of Open Source Geographic Information System for Flood Alert System Development

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Abstract:- These All over world demand for software development using open source technology that are beneficial for software costing. This paper is based on implementation of GIS and improves software structure using open source technology. Now the term GIS is a system designed to capture, stores, manipulate, analyze, manage and presents all types of spatial data related to earth using proprietary GIS platform, that provides functionality and services for GIS processing operates by only GIS analyst. It is required to develop extensible open source applications with GIS functionality according to application needs that are easy to operate by GIS user as well as common user using open source technology in comparison to costly software licenses, restriction on use, interoperability, extensibility, ease of use and performance with increased decision making process. This paper presents the development of such software keeping in mind a specific application, viz. flood alert system.

Keywords:- GIS, Open Source, MapWindow GIS, Flood Alert System, DSS.

I. INTRODUCTION

The Adaptation of open source GIS for Flood Alert System development is greater understanding of evolution of GIS through open source technology and difference between open source and proprietary software in term of cost, service and support, innovation, usability and to generate intelligent open source software structure with improved decision making capability.Open source software capabilities are customized for the GIS capability and services to achieve appropriate GIS application. This paper presents the development of such software keeping in mind a specific application, viz. flood alert system.

A flood is a hydrological event characterised by high discharges and/or water levels that can lead to inundation of land adjacent to streams, rivers, lakes, wetlands and other water bodies. There are essentially two major causes of flooding [7]:

1. Coastal flooding: - which is caused by higher sea levels than normal, largely as a result of storm surges, resulting in the sea overflowing onto the land. Coastal flooding is influenced by the following three factors, which often work in combination: High tide level; Storm surges caused by low barometric pressure exacerbated by high winds (the highest surges can develop from hurricanes); and Wave action which is dependent on wind speed and direction, local topography and exposure.

2. Inland flooding: - which is caused by prolonged and/or intense rainfall. Inland flooding can include a number of different types:
1. Overland flow occurs when the amount of rainfall exceeds the infiltration capacity of the ground to absorb it. This excess water flow overland, ponds formed in natural hollows and low-lying areas or behind obstructions. This occurs as a rapid response to intense rainfall and eventually enters a piped or natural drainage system.
2. River flooding occurs when the capacity of a watercourse is exceeded or the channel is blocked or constricted, and excess water spills out from the channel onto adjacent low-lying areas.
3. Flooding from artificial drainage systems results when flow entering a system, such as an urban storm water drainage system, exceeds its discharge capacity and the system becomes blocked.

GIS Software Solution for Inland Flood Modelling:
Flood Alert System:- It is a GIS software structure used as alert system to flood, provides GIS based facilities, services to the user with optimum decision making support system that are implement using open source technology. [7]

The software system provides following facilities:

Analysis of flood: User can load and analyse a spatial data. And also find flood affected regions on map, this is indicated by the some signals standard, such as:

White signal: Alert.

Blue signal: Ready for Evacuation.

Red signal: Immediate Evacuation.

Search: Find attribute or spatial data on map using Query builder.

Alert SMS Service: Send SMS alert from flood to the security agencies.

II. ADAPTATION IN FLOOD ALERT SYSTEM

The following are the aspects which need to be optimised in Open Source GIS to adopt to flood control application:

1. *No spatial Analysis required:* User can perform and find flood areas without spatial analysis so that the system software can be easy to operate by common user.
2. *Avoid Spatial data Redundancy:* Normally, the demonstration of result requires loading multiple shape files on system. But in this system all results can be visualized with a single shape file.
3. *Alert SMS service:* One can send SMS to the security agencies, like police station and hospitals, to alert from flood.
4. *Decision Support system:* Previously, the flood measurements and decision support system were tacked by a GIS expert and later all calculations were done by system internally and gave direct visualization result on map with improve decision making system software.

III. OPEN SOURCE TECHNPLOGY

Open source software can be defined as software distributed under such a licensing agreement that allows the source code (computer code) to be shared, viewed and modified by other users and organisations.

MapWindow GIS with VB.net Plug-ins: MapWindow GIS is open source GIS application software with a set of programmable mapping components. The MapWindow open-source GIS platform is a system which contains a great deal of simple, straight-forward GIS functionalities which, in overall, are enough to meet the needs of diverse users. However, the greatest positive aspect of MapWindow is that it is not limited purely to the base functionalities provided, but instead allows a fully extensible plug-in interface that allows users to customize their MapWindow functionality to meet their custom needs with some fairly simple .NET code. Other font types may be used if needed for special purposes. [1]

IV. METHODOLOGY

Planning is crucial to the successful implementation of the GIS supported solution.Figure1 show system architecture with MapWindow is a open source platform that visualize spatial data on map using vb.net plug-in.you can also implement or customize Mapwindow according client needs.
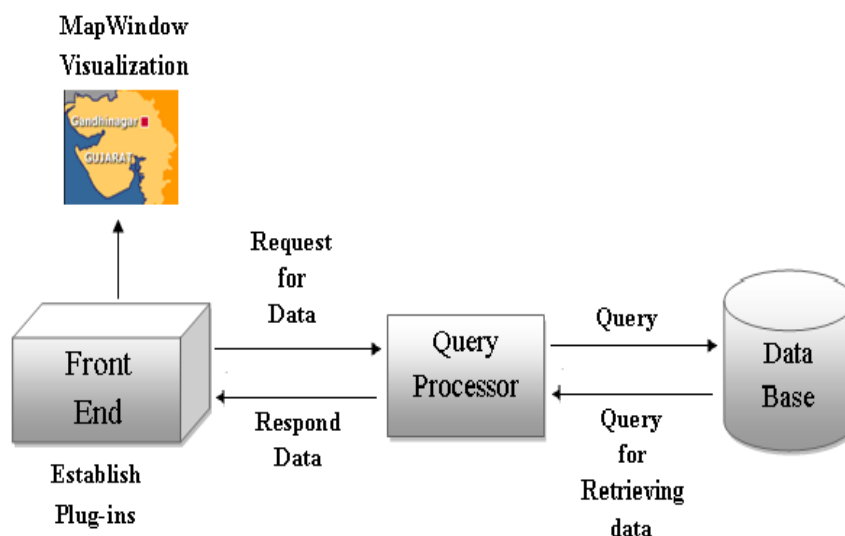

Fig.1: System Software Architecture

Fig 2 captures the flow of activities that were undertaken to realize this research. It comprises four phases.
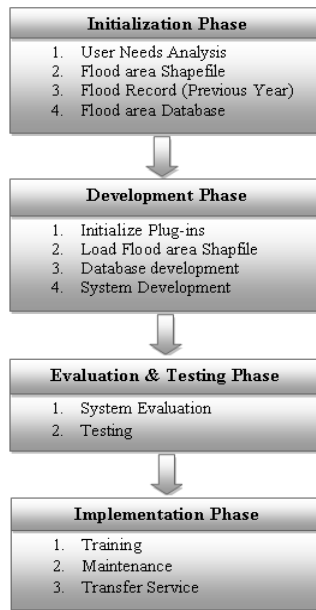

Fig 2: Software Development Cycle

*1. Initialize Phase***: -** Initialization/Conceptualization phase consists of detailed inventory of the current and future needs. In this phase, all entities that are needed to be stored in the database and their relationship are identified, spatial data is created, and the flood record for flood area on which one wants to work on is collected.

TABLE I
USER NEED'S ANALYSIS

S. No.	Need Analysis
1.	Services used by common user as well as GIS user.
2.	Flood calculation easy to perform.
3.	Flood result visualization on map.
4.	Spatial data search quickly on map.

*2. Development Phase***: -** In this phase, the plug-in initialized through MapWindow GIS using .Net framework. Firstly, set-up all necessary settings and refer to MapWin GIS packages and MapWin OCX components on the .Net platform. After that all plug-ins effect shows on MapWindow GIS platform. The necessary database schemas are collected relating to the area of interest. Then establish their connection to the system via explicit database connectivity. The entire system designed identifies various features and functionalities needed to be implemented to address all of the user needs. The system was developed following the Object Oriented Programming concepts through vb.net plug-in. Table II shows initial plug-ins with their menus.

TABLE II
FLOOD PLUG-INS WITH MENUS

S. No.	Plug-ins Menu	Description
	Flood Plug-ins	
1.	Load Spatial data	Load spatial data on system.
2.	Flood Alert	Show alert from flood.
3.	Spatial Search	Search attributes data.
4.	SMS Services	Send SMS.

*3. Evaluation Phase***: -** The evaluation phase is used for rigorous testing of all the implemented features of the prototype, carefully assessing how well the proposed system was able to address all the needs of the end users. In this phase, any refinements required are being undertaken. In case of major refinements, they are developed and incorporated in the prototype and again revaluated. Hence the development and evaluation phase feedback

and forward until a stable prototype is achieved. It is during this phase that user manuals and system documentation are written. [11]

*4. Implementation Phase***:-** In the implementation phase, the prototype is migrated to relevant organizational network that one wants to work on, installed and configured for usage. A maintenance schedule is currently being discussed with the organizational users and members keeping in view the system updates and incorporating new ideas and needs. [11]

V. RESULTS

The following features were included in the solution:

1. **Set-up Plug-ins:-** "Flood Area Plug-ins" with Plug-ins Menus Like: Load, Spatial Search, Flood Alert, Alert SMS service, menus show under red box in following figure.
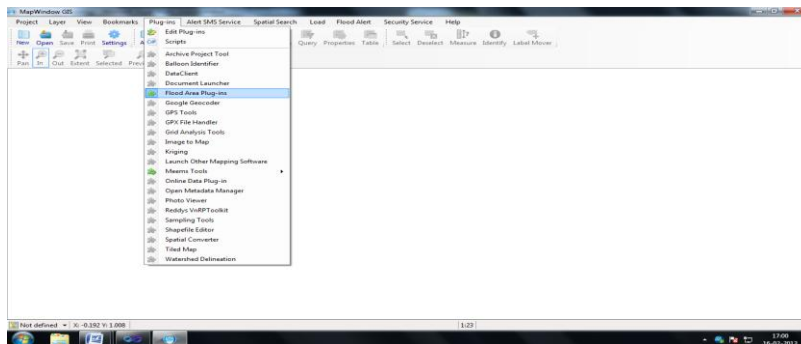
Fig 3: Plug-ins with Plug-in Menus

2. *Load Spatial Data***: -** User can load any type of spatial data related to earth.
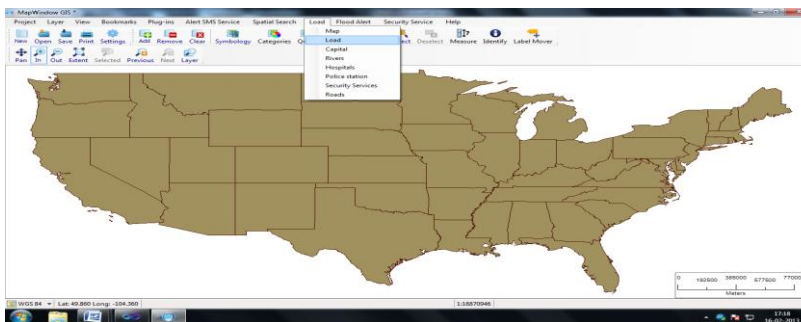
Fig 4: Load Spatial data using Menus on Gujarat state map.

3. *Spatial Search***:** Attribute data search on map using query form.
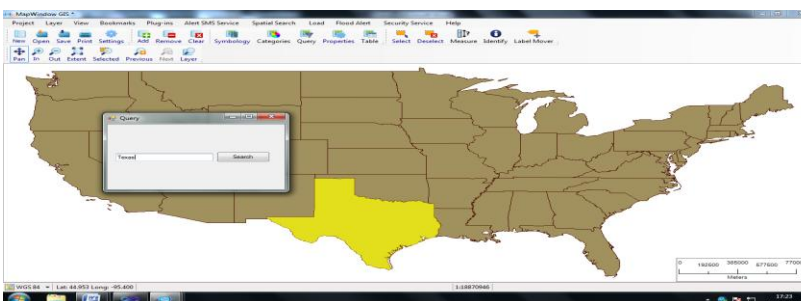

Fig 5: Search attribute data using query Form

4. *Flood Alert***:**-Using this Plug-ins menu, find the flood affected area according to the flood range visualize on map, using following signal standard for visualization flood affected region.

TABLE III SIGNALS STANDARD

S. No.	Signals	Description
1.	White Signal	Alert
2.	Blue Signal	Ready for Evacuation
3.	Red Signal	Immediate Evacuation

Water level ranging from 30 to 35 meter is shown in WHITE colour as ALERT from flood.
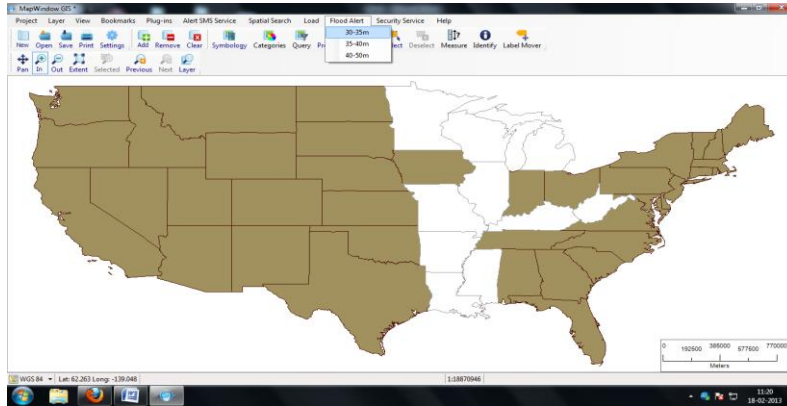
Fig 6: Show white signal water level ranging from 30 to 35 meter

Water level ranging from 35 to 40 meter is shown BLUE as READY FOR EVACUATION and also some areas are come in WHITE range when flood level rises.
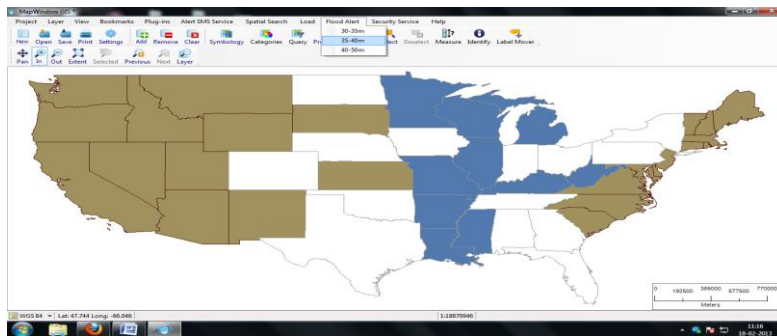
Fig 7: Show blue and white signals water level ranging from 35 to 40 meter

Water level ranging from 40 to 50 meter is shown in Red signal as IMMEDIATE EVACUATION and also some areas come in blue as well as white ranges when flood level rises.
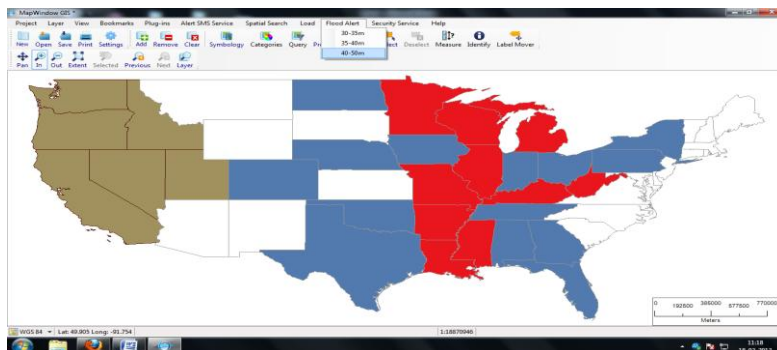
Fig 8: Show Red, blue and white signals water level ranging from 40 to 50 meter.

5. Send Alert SMS: Through this Plug-in menus send SMS to the nearest security service**.**
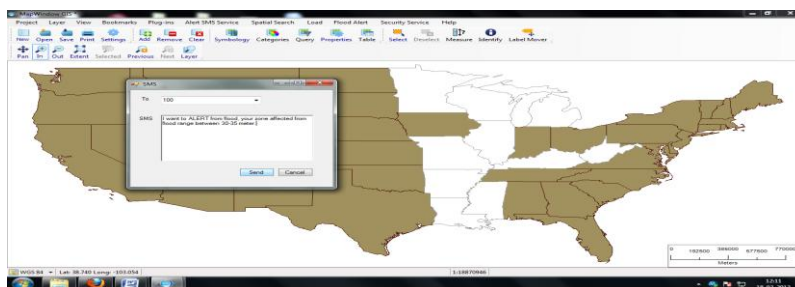
Fig 9: Send SMS via SMS Alert services

VI. CONCLUSION

An open source desktop geo-computing application featuring GIS tools for organization using flood alert system is developed. The proposed system developed is capable of delivering the following services:

1. Adapt GIS capabilities and services for particular GIS application.
2. Spatial data search and visualize on maps.
3. Remove spatial analysis and operation from user side using open source technology.
4. GIS software solution easy to operate by common user as well as GIS user with improves decision making support system.

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