# MOBILE GIS IN GROUNDWATER POLLUTION MONITORING APPLICATION

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**Abstract: Today information systems play key role in various scientific applications including in environmental monitoring. Geographical information system (GIS) is a special class of information system which is spatial database and has numerous applications in the spatial domain. The information technology is moving wired to wireless network which is the basis for mobile computing. This is any where any time and anything computing is the order of the day. In this application mobile GIS, which is a spatial network environment, is proposed, which can perform monitoring of emission levels at a city level or country level or Global level. The concept will be as follows. The analog data of Automated groundwater pollution (AGPMD) monitoring devices will be converted into digital form where by the respective Clint device will transfer data to the server using wireless application protocol (WAP) the hardware and software system need to be integrated where by the mobile GIS components include groundwater pollution data, receivers/analyzers WAP clients of GPS enabled system routers are linked to a GIS with relevant software. In recent times of environmental pollution monitoring by automation has been well received. In this paper using mobile GIS pollution of water bodies are monitored and models are developed for subsequent prevention of pollution. The details are given, in this paper, the mobile GIS based system, its principles of operation hardware and software requirements and the conceptualization are presented. This system is believed to be idealistic for the monitoring of groundwater pollution levels as per international standards.**
**Keywords: GIS, Mobile GIS (MGIS), Wireless GIS (WGIS), Emission, Environment, WAP, Spatial database, Automated Pollution Monitoring Device (AGPMD), Groundwater, pollution**

## I. INTRODUCTION

In simple GIS as spatial data handling system.GIS data can be defined as a computer system, which is used for collection, simulating, processing, searching, analyzing as describing geographic data, in brief, GIS can be treated as an integrated computer science subject with spatial applications. Mobile GIS (MGIS) the latest advancement of GIS is mobile geographic information system (MGIS). In other words MGIS can be considered as that branch of GIS which is portable and can be taken to the field, whereby it can interact directly with the field input through the latest technologies including WAP (Fig-1). The important components of mobile GIS are

- GIS Server Mobile hardware
- Global Position System (GPS)

- WAP communication for net based GIS access

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AGPMD

WD

AGPMD

WD

AGPMD-Automated Groundwater
Pollution Monitoring
Device

WD- WAP Device

**WIRELESS
NETWORK**

WD

WD

AGPMD

WD

AGPMD
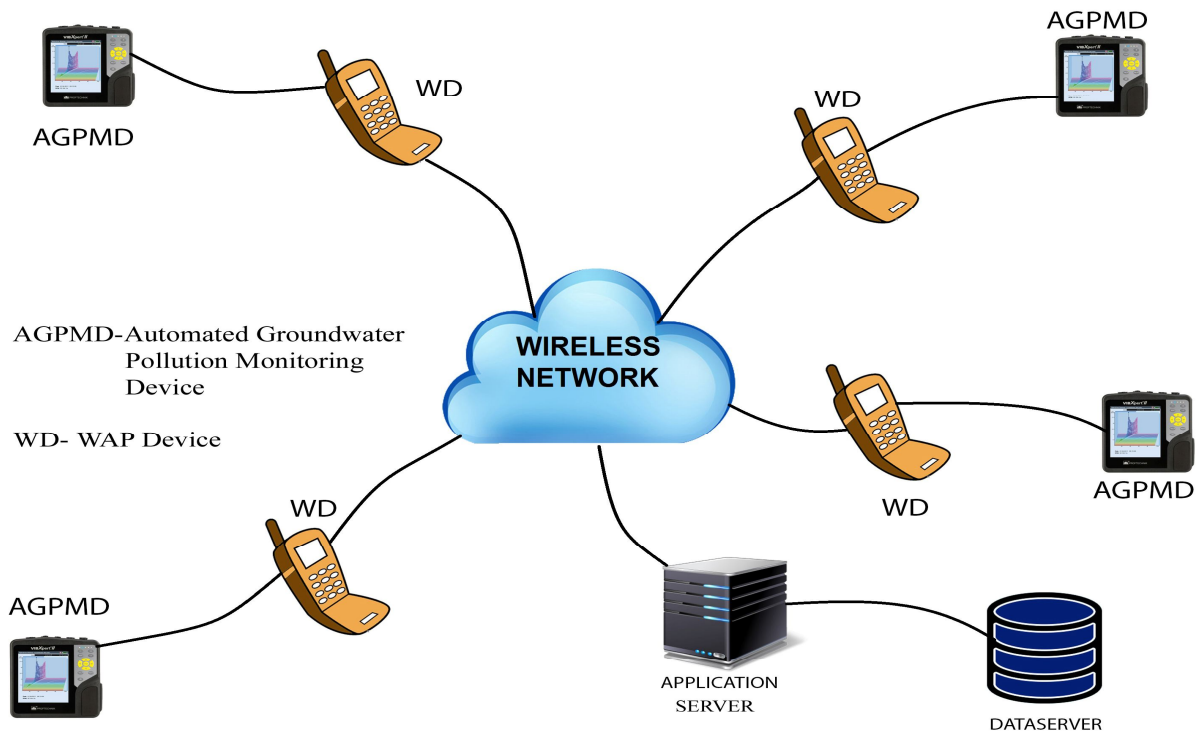
APPLICATION
SERVER

DATASERVER

Fig.1 Schematic Diagram Showing the Proposed System

Historically the data for spatial databases come from extensive field surveys. These surveys for data collection, data plotting, map preparation, map editing were highly manual, time consuming and error prone. Once the data are collected it will be taken to the office where field maps are deciphered and manually entered into in to GIS database. Naturally the resulted spatial database cannot be that accurate and resulting conclusions or discussions cannot be authentic.

Recent developments in hardware and software technologies especially in mobile methods of computing ( Rao, 2004, Coal 1999, Li and Yang 2004, Lugun and Mnglu, 2004 Jie and Jun, 2000, Lingkui,et. al 2004) also revolutionized the concept of the GIS. The element of the mobility in data inputting devices resulted, a great boon to the traditional GIS system. This almost eliminated the manual methods of data collection and data inputting. Instead the portable device with WAP enabled the user not only for inputting the data but also to retrieve information from the servers into his hand – held devices right in the field.

## II. MOBILE GIS  VS WIRELESS GIS

Mobile GIS and Wireless GIS are very similar and can be called as Wireless web – GIS. In this mobile communication area, GIS network were usually divided into two types according to the wireless connection technology. One is based on the cellular Infrastructure connection technique, which is also used for Mobile GIS; the other is based on the wireless LAN     techniques. Wireless network is a network, which is built, in a mobile environment, or the environment - combined wireless with wired. It is quiet convenient for data transferring network.(Fig-2), The common components are
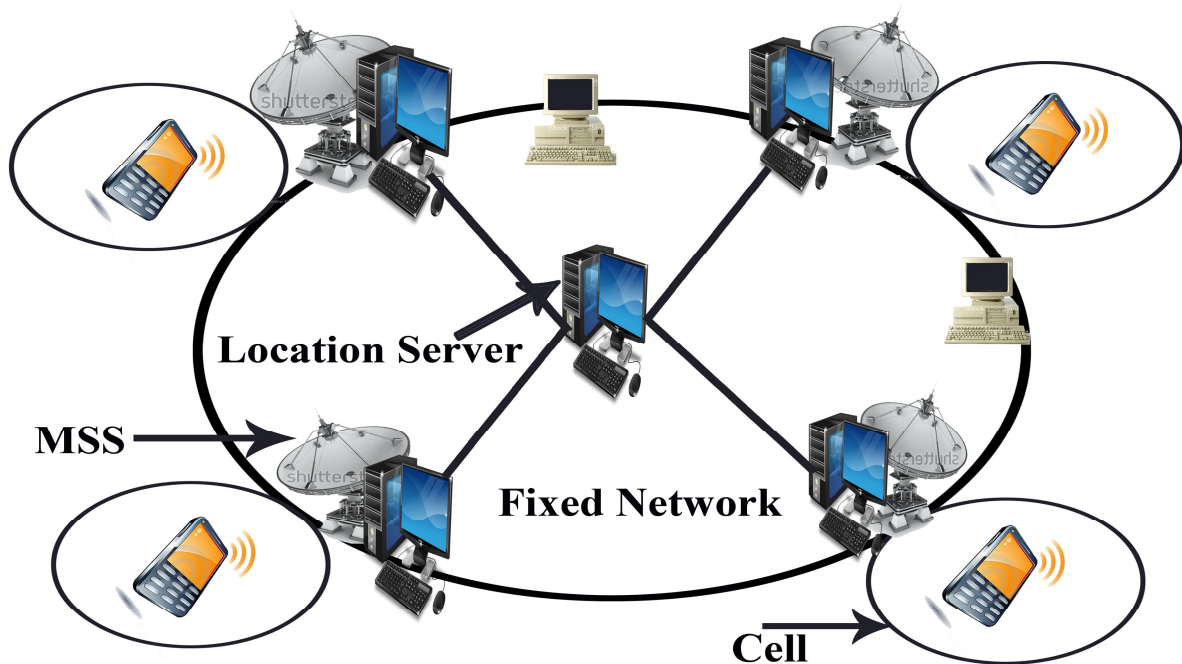
- The Client The server
- The network

Fig.2 Schematic Diagram of the Mobile Environment

The main differences between these two are in client devices and server software. In the purely mobile GIS application users can interact with GIS data and maps on the web. This application mainly serve the public and can be considered as business to customer service( B 2 C).The Wireless GIS application is also similar but the user need to have privilege – permission to a non GIS data base and also should own GIS software for accessing. The database and for other manipulations. These applications can either B 2 C or B 2 B.

## III. LIMITATIONS OF WIRELESS WEB

Main limitations of this application are perhaps related to the limitations in web devices like low bandwidth and low reliability. The problem of small screen and less resolution may be a big obstacle, which may result a non user- friendly interface. Similarly the limitations of non-support of vector data format by the mobile web browser and plugins need to be eliminated. However the recent development in the hardware and software technology will be able to eliminate these problems.

## IV. AUTOMATED GROUNDWATER POLLUTION MONITORING DEVICES (AGPMD)

Every well will represent an unit of the ground water aquifer and the water quality of the well will determine the pollution levels of the aquifer of that well, but the problem occurs when the pollution is beyond the standardized values. The primary reason for this breach of industries in the region which will discharge untreated wastes to the natural environment, resulting pollution

of water bodies this pollution can be checked with the proposed application. The aim of this concept is to monitor and control the pollutants in the water bodies by using the pollution control circuit. This pollution control circuit consists of various sensors pH, hardness, alkalinity, salinity and other toxic parameters and GSM, GPS kind of devices, and all of them are integrated and connected to a Controller. In a real time work in which various sensors are used and a controller board is made where all these devices get integrated and work accordingly on board a vehicle. When a circuit on board the vehicle attains certain threshold pollution level then the a report is generated and sent to the pre-defined number stored in the memory through the GSM module. The GPS module is used to locate the well and aquifer. This paper demonstrates an effective utilization of technology by which we save our environment by controlling the pollution of water bodies

## V. WAP

In recent times WAP has become the magic word in software applications. The WAP specification is mainly XML (Extended Markup Language) called WML (Wireless Markup Language) which is capable of issuing requests and obtain required output. In the present application the spatial data will be based on spatial entity and hence the WAP should support the Wireless bitmap files. Fortunately WAP have reached such a stage, now it has the enough capability to handle such files. It is now a reality where by it is possible to receive and send spatial data through WAP devices. The data from the AWMD s will becomes an attribute data and transferred to WAP with GPS where by it will be transformed to respective Geographic entity of a map and will be updated in the server.

## VI. Hand Held Devices:
Recent advances in hardware design resulted the development of highly portable and small devices, which are highly suitable for mobile applications. These devices are small but capable of handling the Geographic applications with power sources like battery packs etc. The current situation is characterized by great diversity with higher end systems offering a quarter VGA screen (320 by 240 pixels), 8-bit color (64 colors), 32 MB of RAM and a 200 MHz or more processor.  The choice of operating systems includes Windows CE, Palm OS, EPOC, JavaOS and Linux.  Some examples of device for the present application include. Pocket PC running Windows CE Palm PDA running Palm OS Smart phone running EPOC Pager with proprietary OS To be useful as mobile geographic clients these devices must be geographically aware, that is, it must be possible to  locate  the  device quickly and  reasonably accurately. Several alternatives are currently available for fixing the position of devices of this type

## VII. Network-based
**Cell Global Identity:** Cellular telephone systems divide geography into base station coverage areas typically of several kilometers in size, although in urban areas they can be as small as 10m. Only the finest resolution of data is of use to mobile geographic service users.

**Uplink Time of Arrival.** U-TOA  measures the time it takes for signals to travel from a handset.   This system supports existing as well as new equipment, but is expensive to implement because of the high cost of upgrades to all base stations.  Accuracies are around 100m.

## VIII. Handset-based

Locating one self in the field is essential component of surveys based on mobile GIS. In earlier times the field investigations used to locate himself by using clinometer compass and taking the reading from standard reference points. But this method is inaccurate and with number of limitations. The recent advancements in the development of portable Global Positioning Systems resulted the establishing the location with very high accuracy (< 1mt.) GPS. The Global Positioning System offers the highest locational data quality.  Since the removal of selective availability accuracies of better than 10 m are possible.   However, there are some limitations in the use of GPS, especially the requirement for line of sight (especially a problem in urban 'canyons'), added cost, and the time it takes to obtain a signal.   Some systems may be complemented by additional GPS receivers located at fixed positions.  This improves location calculation from 20-45 seconds to 1-8seconds. Enhanced Observed Time Difference.  E- OTD triangulates data received from base stations.   This requires that the location of base stations is accurately known and that data signals are synchronized. The accuracy of this method is estimated to be around 125m.

## IX. GEOGRAPHIC APPLICATION SERVER

The  server  is  most  important  part  of  the  present application and should be capable of providing wide ranging applications. The recent advancements enabled the development of servers with amazing capabilities, these include.
Rich functionality: The services like high quality mapping, geographic and attribute quarries data downloading, geocoding, routing and report generation must be available.
**Good performance:**  Performance is critical for applications servers of this type because they must be able to process many requests simultaneously and potentially millions of requests per day.
**Scalability:** This includes the ability to deal simultaneously with both very large data sets and very  large  number  of  application requests.
**Reliability:** The server should be robust and reliable since they have to work round the year. Hence the standard hardware, GIS and DBMS software should be selected. The designers should ensure the software and hardware systems are of International standards    and      have compatibility   with networks around the Globe and also with futuristic systems and applications.
**Geographic database:**

The final component is a geographic database containing the content that will be made available via the Geographic services in the application server. Data management and high throughput for large databases is enabled by the use of commercial of the shelf relational database management systems such as DB2, Informix, Oracle or SQL Server. The same software can be used to store and manage both the geographic and associated attribute data.
**The Expected outcome:**

The servers can handle the continuous data input from different clients of area of operation and the database will automatically updated. The users will be having privilege to access the data and can manipulate into updated maps, reports and other graphics. The spatial database system can have all these options and further can be integrated with other software's whereby export of data to other network is possible. The privilege of users can be limited and these are dependent upon

the security options, which can be decided by all the countries involved in this system.


## X. CONCLUSION

A mobile geographic service is a fast growing field of GIS. Although there is much hype associated with the technology, it is clear that even today technology is finding real business benefits in using geographic information in a mobile context. An innovative application of mobile GIS is presented to routing; to data collection there are many success stories.

This system is better used to have a potential network- based groundwater pollution monitoring with international standards so that the international environment agreements can be implemented in a scientific manner. Since the standards of hardware, software in the network are uniform and controlled at one place there will not be any issue of confrontation in deciding the levels of pollution.

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