AN INTELLIGENT REAL TIME FIELD DATA ACQUISITION SYSTEM

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Abstract

With the advancement of technology, scrutiny and management of resources had become quite easy and remote sensing and GIS has put on a great significance. Wireless telecommunication and SMS based services has attained a lot of popularity due to its reach to the ground level and low cost competence. This paper presents a novel approach for real time field data acquisition integrating wireless technology, SMS based services and remote sensing for exhaustive field survey. It includes designing of a high end mobile embedded system, incorporated with the Global Positioning System and wireless telecommunication services. This system would be capable of capturing the geographical coordinates of target location automatically and will have a definite scheme to gather all the desirable parameters of that location required in the survey. The system will also contain a comprehensive receiver for data digitization, conversion, storage and exploitation in mapping services.

1. Introduction

Pertinent planning of the existing resources present in the area is the key to success and development of the region. And to achieve this objective various high end technological models have been formulated and are being continuously used. Remote Sensing and GIS are most common among these techniques.

However all the parameters of any object cannot be gathered by the help of imageries obtained using Remote sensing techniques or incorporating GIS, an exclusive field survey in obligatory for gathering complete information. Thus remote sensing technologies in conjunction with field survey incorporating GPS (Global Positioning System) technologies complete the exhaustive scanning of the resources present in the area.

The traditional methods of field data capturing includes the use of topographical maps khasra plans etc. of the target region. Along with this a huge man force is required for scanning every corner of the target area and completing all the stages of survey like data collection from field, tabulation of data according to the specified standards, preparation of reports as well as backup of data and finally weaving the data over physical maps of that area. This enhances the chances of error in the data gathered and is quite uneconomic. It consumes a lot of time.

For simple and light end applications, the system of data acquisition can be slightly different from the conventional one. Existing resources and wireless telecommunication facilities may be integrated along with the traditional techniques. This can increase the efficiency and reduce the overall budget as well as work force, required for the purpose, to a very great extent. Replacement of conventional GPS receivers by a more effective, economic, user friendly and simple electronic device that can embrace more functionality as compared to existing gadgets can be an unexampled approach in this arena.

This paper presents a novel approach for real time field data survey. It includes designing and implementation of a high end mobile embedded system, integrated with the Global Positioning System and wireless telecommunication services. This system would be capable of capturing the geographical coordinates of target location automatically and will have a definite scheme to gather certain desirable parameters for remote data acquisition. The system will also contain a comprehensive receiver for data digitization, conversion, storage and exploitation in mapping services.

2. System Model

The methodology proposed here comprises of a self-referent system implemented to collect the data from field and form a database at the remote end simultaneously thereby implementing it to sketch out a reference map using GIS and other mapping application software.

It has an electronic gadget, which is a cellular phone embedded and programmed for this task, in the

target area. This is used to collect the data digitally and transmit it using wireless technology in the form of SMS. At the remote end, the system is terminated with a modem and a local server. The modem is dedicated for receiving the information (SMS) and transporting it to the server. The server has a built-in database to store the data and channel it to cartographic software in order to generate an indicative map of the information collected. The system also has a web application to view the records of data stored and format it accordingly.

The following figure 1 describes the complete architecture of the real time field data acquisition system. It has been divided into transmitter and receiver sub section interconnected with the help of GSM Network interface.

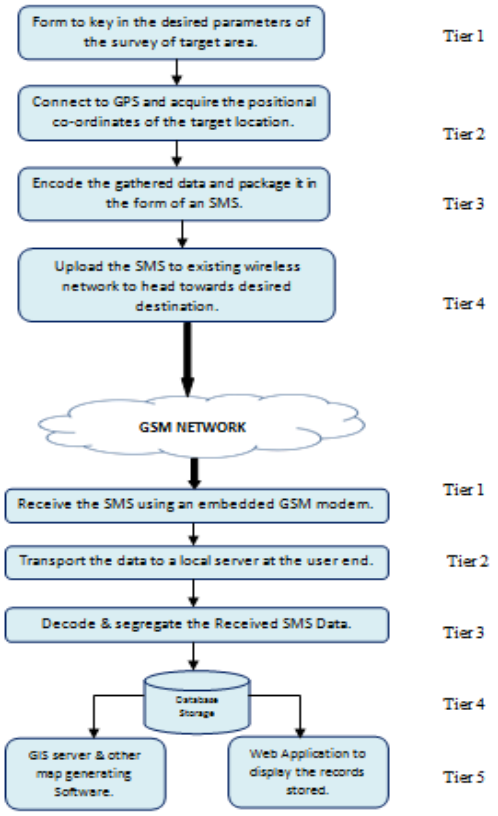

Figure 1: System Block Diagram

3. Design of data transmitting equipment:

The transmitting equipment used in this system is an embedded mobile phone. It must be incorporated with an in built GPS receiver. Here a mobile phone is converted into a dedicated device used for retrieving the geographical coordinates of the location of the cell phone within a particular application. Moreover the device will also have an inbuilt application to gather necessary parameters of the target survey. This application will have a flexible architecture so that the displayed heads can be varied in accordance with the requirement of the survey. [1]

As a final point, the data entered in the application and positional co-ordinates gathered by the help of GPS services are integrated into a single package and transmitted in the form of SMS through the existing wireless telecommunication network.

The integration of a task specific application in a particular mobile phone solely depends upon the software environment in which the device is operating. Thus a detailed comparative study of all the Mobile Operating System dominating the market is done and the best one found for this purpose is Android based mobile phones, Being based on Linux, this is the only truly open operating system that is flexible and allows major changes in the operating system and offers common basic standards for programming so as to make the mobile device as a complete dedicated Personal Digital Assistant (PDA). [2]

Development of application at transmitter:

The main motive of any operating system is to execute the applications installed over it whenever the user calls and Android provides several means on different layers to compose execute and manage applications. Any application developed for Android OS consists of various diminutive elements packaged in a single executable file and at the run time these all connect to each other in a specific manner to give the output as a whole. These elements are known as Application Components. There are four types of application components viz. Activities, Services, Content providers and Broadcast receivers. Each type serves a distinct purpose and has a discrete lifecycle that defines the creation as well as demolition of component.

Intents are used to start other applications or explicit components of other applications. These are generated and send by the base application. The Internet Manager resolves incoming intents and starts the proper application or component. The reception of Intent can be filtered by an application.

Services and broadcast receivers are used to perform jobs in the background and provide additional functionality to other components within the application. Broadcast receivers can be triggered by an event and run for a short period of time whereas lifetime of a service may be quite long.

The compiled code of the application components and additional resources like libraries, images and other necessary data is packed into a single .apk file that forms the executable Android application. [3]

A novel application can be constructed using the above components for the task mentioned in the previous article. [4]

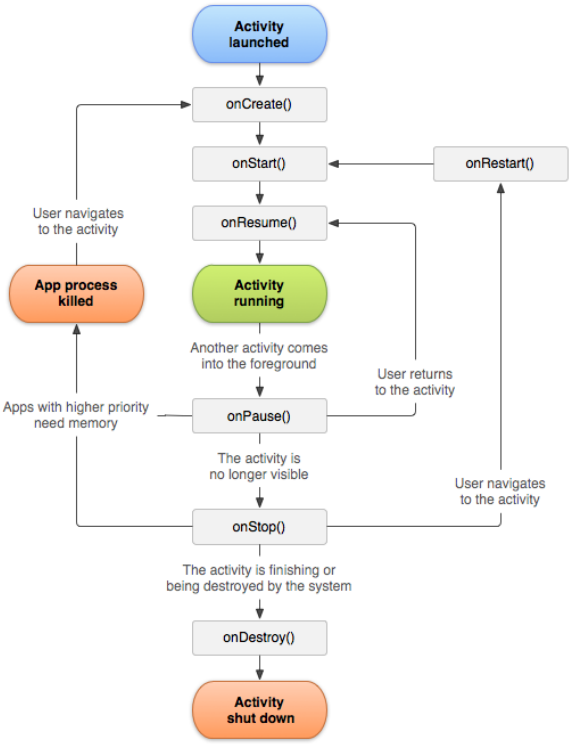

Figure 2: Android Application Life Cycle

4. Design of data receiving equipment:

The functioning of receiver end is to congregate the SMS containing field information from various transmitters and store it into a server parent database. For this, the receiver side must be equipped with a system dedicated for retrieval of SMS and its storage in a computer terminal. This can be done in many ways like,

Wireless Carriers: A standard for telephony messaging systems that allows sending messages between mobile devices consist of short messages, normally with text only content. However, there are certain applications, which use Short numeric numbers (typically 4-6 digits) as destination of text messages that are sent from a mobile phone. This is done using wireless carriers. The Wireless subscribers send text messages to common short codes with relevant keywords to access a wide variety of mobile content. This Keyword is a word or name used to distinguish a targeted message within a Short Code Service.

SMS Gateways: To send and receive SMS text messages on server, another way is to directly connect to the SMSCs (SMS centers) of the service providers and this can done using some particular gateways known as SMS Gateways. Such Gateways connect to the local server through internet and channel down all the dedicated messages directly to our server.

GSM modems: A GSM modem is a wireless modem that works with a GSM wireless network basically intended for surfing Internet. It can be an external device or a PC Card. Typically; an external GSM modem is connected to a computer through a serial cable or a USB cable. It requires a SIM card from a wireless carrier in order to operate. These modems once connected to USB port of the computer terminal can be driven accordingly by the help of special commanding signals.

The modems are categorized as USB modems, Bulk SMS modems and Serial modems. The USB modems offer a very slow rate of data transfer. Bulk SMS modems are intended for reception of a large number of SMS in short duration of time and are quite costly. Thus, concentrating on the extent of utility in terms of average number of SMS received per day, the receiver is designed using a simple Serial modem device. [5]

The parent database also acts as a basis for a website module intended for displaying of all the collected information and cartographic software's. The data acquisition device of this subsystem is a computer server integrated with an embedded wireless GSM modem.

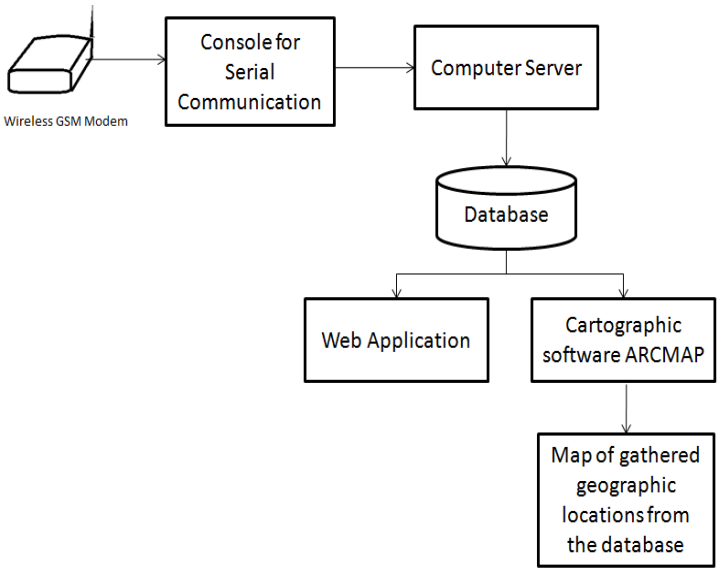

Figure 3: Design of Receiver System

The above figure 3 demonstrates the basic building blocks of the receiver side of Data Acquisition System (DAS). The wireless GSM modem is connected to a computer server via RS-232 cable and can be

accessed by means of a console developed through programming. The messages received by the modem can be retrieved at the computer terminal using a definite command set known as AT commands or HAYE'S commands. The information retrieved is decoded and converted into usable format and then parsed and saved into the database. The database can then be connected to any cartographic software to generate a digital map of data. And a separate web application can be developed to display the records stored in database.

Advantages of the system: Such a system can prove to be a great advancement in the area of field data collection and surveying. It can incorporate commonly available technologies for dedicated purposes eradicating innumerous disadvantages of traditional and conventional approaches. The advantages of deployment of this system can be summarized as follows:

1) Using a mobile handset as a GPS receiver can overcome various error caused by conventional GPS devices. These errors can be selective availability, satellite geometry, satellite orbit, multipath effect, atmospheric effects, clock inaccuracies and relativistic effects. Use of mobile handset provides an additional of being tracked continuously by the network providers. These providers have the actual location of the handset and the mobile handset GPS receiver can be assisted with the information provided by network. Finally the location gathered by inbuilt GPS receiver and that given by the network can be compared and errors can be removed.

2) Surveying and data collection can be completed in real time. Traditional methods involved capturing of data by means of topographical maps and paper records. This method can eliminate the usage of such maps and manually produced records.

3) Cost effective and economic as compared to previously used technologies.

4) This technique also provides an easy monitoring of the survey.

5) The data gathered is more accurate as well as secure. There is no scope of data manipulation in between thus forming a rigid architecture as a whole.

5. Conclusion

The proposed system is capable of collecting the field data along with positional information and form a record automatically at the remote server. Moreover it is also capable of generating maps from data stored in the database. The system can be enhanced by equipping with the facility of trans-receiving the field images along with the existing parameters using the same SMS technology. For this various kinds of image encoding techniques like base64 encoding, Huffman coding etc. can be used which can convert the image into a string and this string can be transmitted in the form of SMS and finally decoded and converted back into image at the receiver. Further image processing techniques can be applied for improving the quality of these images. If implemented, this technique would be quite cost effective for commercial purposes also as the pictorial communication can be made possible with the help of simple SMS technology instead of other higher end technologies.

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