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Map-Based Querying for Multimedia Database

by Somiya Metu

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1. Introduction

This report describes map-based querying for a multimedia database accessible via a custom Web service and augmentation of the Android Tactical Assault Kit (ATAK), version 2.0, to gather spatial information from the map engine. The information is used by a custom Android application that communicates with the database Web service. ATAK is an Android-based application developed by the US Air Force Research Laboratory that uses maps to allow for precise targeting, intelligence on surrounding land formations, and generalized situational awareness. The custom Android application takes spatial information from ATAK and uses it to formulate a query, invokes the database Web service, and provides a viewer that displays the query results. Thus, the application employs map-based querying to efficiently search for existing assets in the area designated on the map and allows users to view the relevant media acquired by these assets stored in a centralized Cursor on Target (CoT)¹ database. CoT is a simple extensible markup language (XML)-based messaging format designed by the MITRE Corporation for the Air Force. It has gained widespread acceptance and usage as an interoperability standard for US and coalition command and control systems. A CoT database has been developed by the US Army Research Laboratory.

2. Development Environment

Google's Android is an open-source software stack intended for mobile devices such as cell phones and tablets. IntelliJ IDEA, Version 13.0.2, has been used as an integrated development environment (IDE) for software development. This IDE has Android support for development of Android applications. The Android software development kit (SDK) and the associated tools are freely available from Google at <http://developer.Android.com>. The target platform Android 4.3 (API 18) was used in this effort, and the Galaxy Nexus phone was used for testing.

3. Application Design

The ATAK application helps select and provide spatial data. Once an area of interest is established by the user via ATAK, control is passed to a custom Android application, which runs independently from the ATAK software. This custom application is responsible for interacting with the database Web service to retrieve information based on spatial parameters. Due to this modular design, ATAK can be easily replaced by any other mapping application, based on future needs.

3.1 User Interface

Figure 1 shows the main screen for ATAK. Basic Android touch screen motions provide various ways to select an area of the displayed map. These include zoom in and zoom out, and slide left, right, up, and down. By way of these touch screen motions, a bounding box of interest can be selected, as shown in Fig. 2.



Fig. 1 Main screen

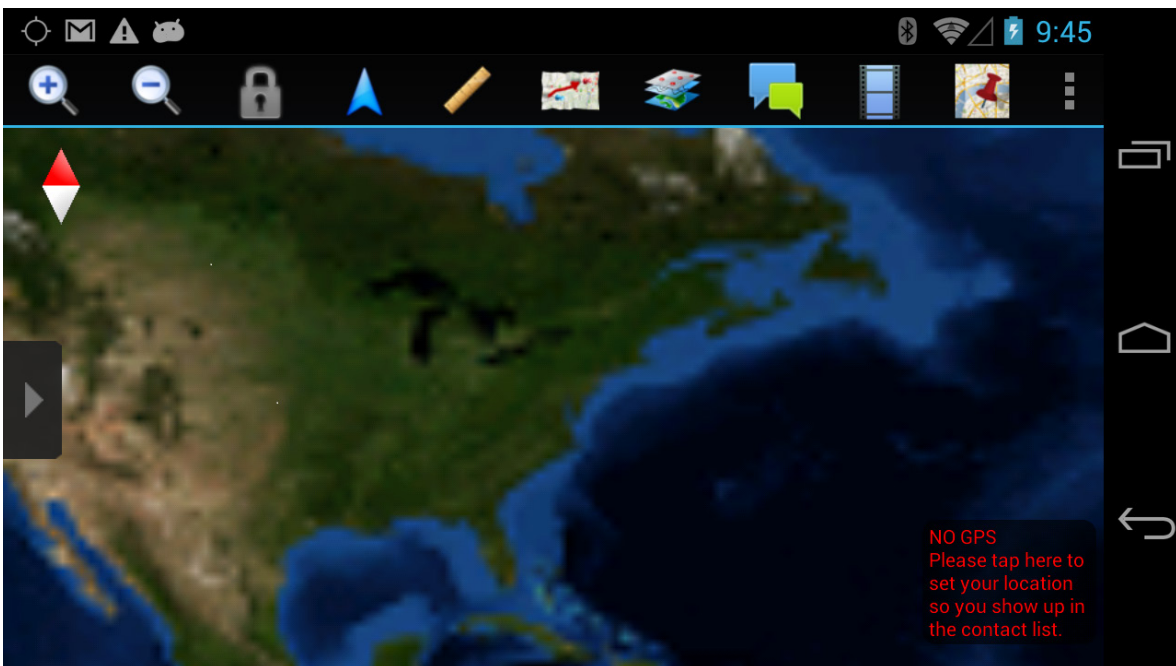


Fig. 2 Bounding box

3.2 Retrieve Spatial Data from ATAK

The spatial parameters, latitude and longitude, are obtained by selecting the bounding box from the ATAK application interface, as shown in Fig. 2. Following this, ATAK's main menu can be selected, which displays several menu options. A menu item, "Send Bounding Box", has been added to the main menu of the ATAK application, as shown in Fig. 3. A selection listener has been added to this menu item, which is triggered on selection of the bounding box. The listener facilitates the transfer of spatial data from ATAK to the custom Android query application responsible for creating and executing the query. The *ATAKActivity* class in the ATAK application software extends the *MapActivity* class from the ATAK Map Library, which is an abstract base activity for applications using the map engine.

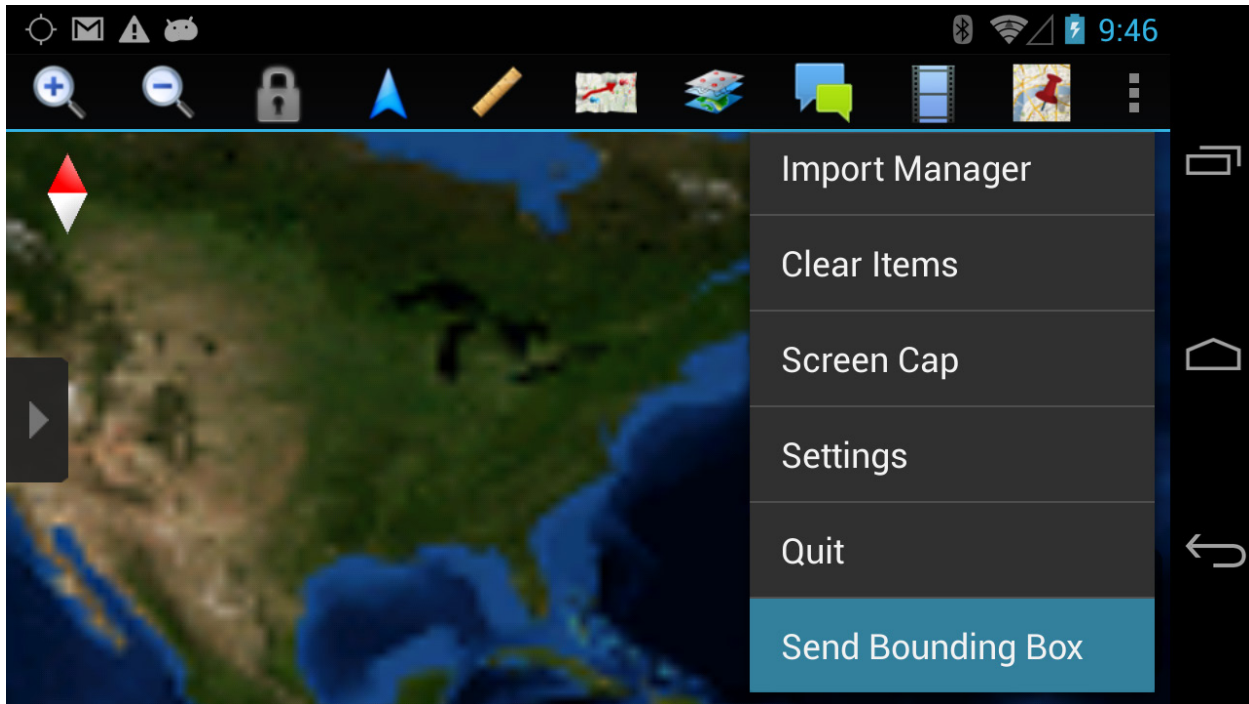


Fig. 3 Bounding box selection

Selection of the menu item "Send Bounding Box" triggers the listener and results in the *getMapView* method being called from the *ATAKActivity* class. The *getMapView* method is an abstract method in the *MapActivity* class and is overridden in the *ATAKActivity* class in the ATAK software. The *getMapView* method returns a *MapView* object, which is basically a content view for *MapActivity*.

The *MapView* class contains various coordinate spaces and also provides a method to convert between those spaces. The geodetic coordinate space and display coordinate space are included in the *MapView* class. The *MapView* object is used to retrieve the latitude and longitude of the bounding box that the user selected.

This information is then passed asynchronously to the custom Android query application. This transfer is done via explicit Android intents, which pass the required information from *ATAKActivity* class in ATAK to the *ARLQueryActivity* class in the custom Android query application.

3.3 Query Construction and Execution

The parameters passed to *ARLQueryActivity* are used in query formulation in the multimedia database. The database contains CoT events acquired from various unattended ground sensors (UGSs) and other sources. The CoT database is wrapped in a Representational State Transfer (REST) Web service, namely, the CoT Web service, for simplified access. The parameter values are assembled in the *OnCreate* method. In order to access the Web service, an asynchronous task called *COTServiceTask* is instantiated. This way the main user interface (UI) thread is not interrupted and a background worker thread is dedicated for Web service access.

COTServiceTask takes a string array containing spatial information to be used in the query. The *execute* method is called from the asynchronous task instance. This method runs on the main UI thread and triggers a worker thread by which the control for the task is handled. The *doInBackgroundThread*, in which the bulk of the work is performed, is then called. In this method, a Web service request is generated. The request string consists of the URL of the CoT Web service concatenated with an *xquery* expression containing the spatial parameters. Listing 1 shows a sample query. Following this, the *connectToService* method is invoked, which takes the request string as its input parameter. In this method, an HTTP client instance is created, which then creates and executes an HTTP GET instance using the Web service request string. An HTTP response is then generated by the client, which is processed to obtain a result string. Once the *COTServiceTask* completes, the result is published to the main UI thread.

```
"http://192.168.1.12:8081/"+URLEncoder.encode("CoTDatabase/events?xquery=/event/point[@lat >= xs:decimal("+ latitude+") and @lat < xs:decimal("+latitude+")]","UTF-8");
```

Listing 1 Sample query of the CoT database

3.4 Query Result

Following the completion of *COTServiceTask*, the main UI thread receives the result string. The result string is an XML string containing CoT event messages from assets that exist in a specified spatial boundary. To parse the XML string, the *parseXMLString* method is called, which parses the XML string and retrieves multimedia data from the CoT event messages. Currently, the result data from the Web service contain only image data. The image data are converted to bitmaps and stored in an *ArrayList*. The *Gallery* view is then used to display the thumbnail images in a horizontally scrolling list. The selected thumbnail image is then displayed using the *ImageSwitcher* view at the center, as shown in Fig. 4. The *Gallery* view is populated by using a custom adapter, *ImageAdapter*, which extends the *BaseAdapter* class. The *ImageAdapter* acts as a bridge between the *Gallery* view and the data, which is an *ArrayList* of bitmaps.

ImageAdapter provides access to the data items and makes a view for each item in the *ArrayList*. This is done by overriding the *getView* method, which returns an *ImageView* object with the user-selected image inside the *ImageView*.

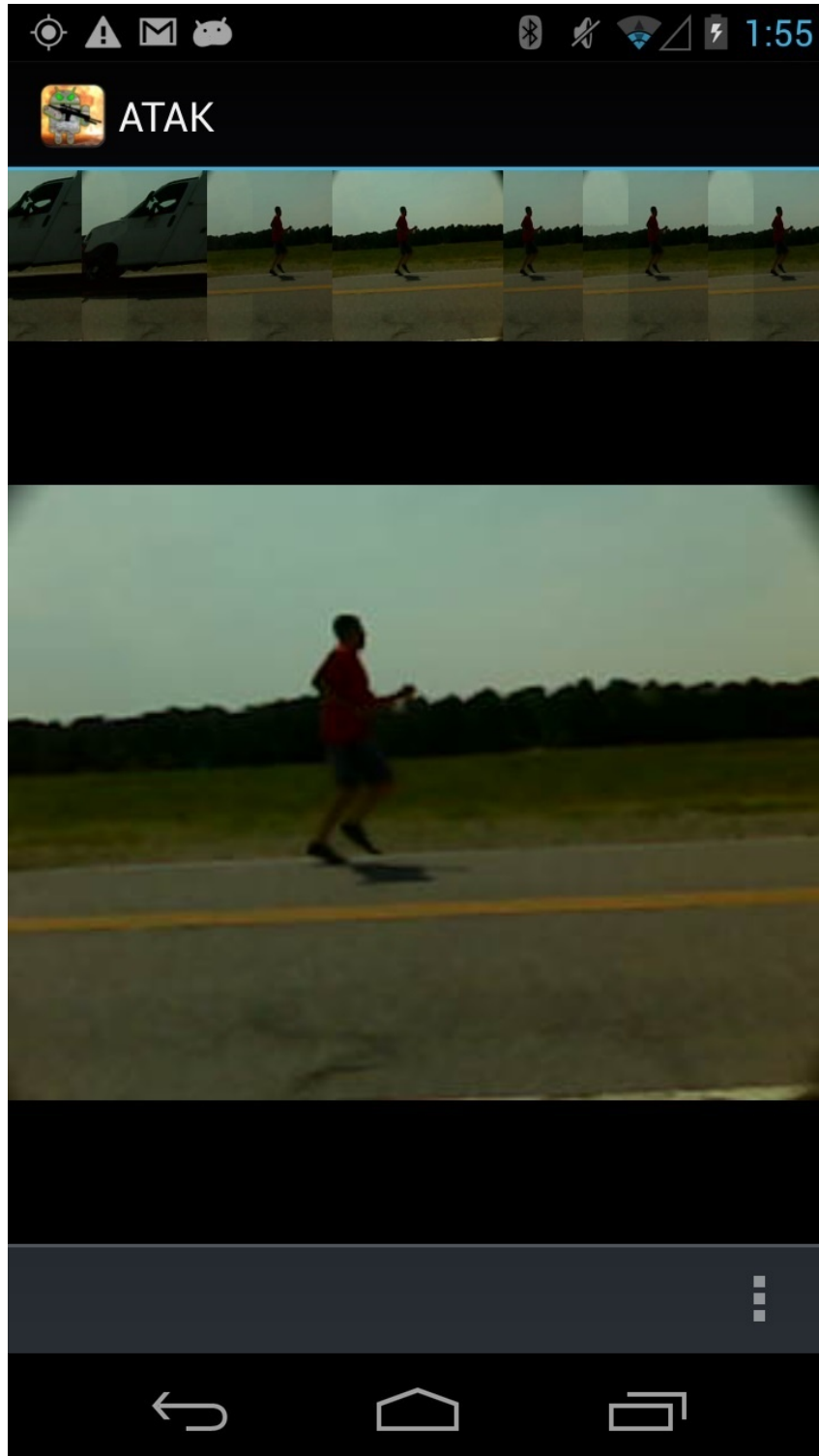


Fig. 4 Selected thumbnail image displayed using the *ImageSwitcher*

4. Conclusion

This report describes a quick approach to query a custom multimedia-based database based on an area of interest. It also describes the use of ATAK solely to select and specify an area of interest.

5. References

1. Butler M. The developer's guide to cursor on target. The MITRE Corporation: Bedford, MA, August 2005.

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2 US ARMY RSRCH LAB
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