Implementation of a Mobile Application for Field Data Collection

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***Abstract*—**With the development of information technology, the working style and live style of people change a lot. Intelligent mobile terminals running Android system become popular in recent years. They are portable and powerful. Field data collection is an important job for researchers and personnel of nature reserve. The traditional method for filed data is error-prone and inefficient. In this paper, we implemented a field data collection application on Android tablets. We transform traditional paper data collection forms into electronic templates. Android tablets can generate data collection interface from a template automatically. With this application, people working in filed can record data easily and efficiently. Meanwhile, this application can integrate tracks with photos, videos and audios to illustrate human activity in detail. At the end of this paper, we look forward the future work.

Keywords—Field Data Collection, Mobile Internet, Mobile Application, KML, Android.

1 INTRODUCTION

With the development of information technology, the working style and live style of people change a lot. Smartphones and tablets have replaced traditional desktops and notebooks to be the mainstream terminals to access network. At the end of 2014, mobile Internet users reached 557 million [1]. About 86% of Chinese users now access the Internet through mobile phones. Most mobile terminals have the features of WIFI, Bluetooth, GPS, camera, etc. Compared with smartphones, tablets have a larger screen and a much longer standby time. Moreover, some tablets support cellular network and are capable of telephony function. Therefor tablet is more suitable for field environment.

Field data collection is an important job for researchers studying on zoology, botany, etc. and personnels of nature reserves [2]. The traditional way of field data collection is to design collection forms and print on paper. It is also necessary to plan a suitable route for data collection. When go outside, personnels need to record data manually on these paper forms [3] [4]. It is easy to write down numbers or some words. While for complicated style of data, it is difficult to record. Such as longitude, latitude, and altitude, personnels have to use professional GPS terminals and write down those long numbers on paper forms. For photos, what they can write down is the sequence number of photo taken by heavy camera. As for the complex species name, it is much more difficult to remember the scientific name.

We conclude the drawbacks of the traditional field data collection way as follows. (1) Non-standard data format and error-prone. Different person has different habitat. It is difficult to uniform the data record manually. For example, during data recording, people will use abbreviation for simplicity. While these data is hard to understand for others even for themselves after a few days. Due to the bad work condition, recording data manually is inconvenient and error-prone, especially for those complex data. (2) High probability to loss data. As is well known, work environment in filed is hard, paper is liable to go broken or lost, which will cause incomplete or missing data. The lack of original data will be a huge loss to the subsequent data analysis and statistics. (3)Reprocessing data. It is very difficult to process data record on paper. For the convenience of data processing, it is necessary to type these data into files, which can be identified by computers. On the one hand, input data into files will bring extra work; on the other hand, it may bring new errors during this procedure. Meanwhile, non-standard data has to be standardized before processed by computers. (4) Data is lacking relation. In traditional field data collection, data of different types is lacking relation, such as observation data, GPS data, photos etc. It is necessary to integrate these different types of data to provide a detailed scene of field investigation and to facilitate data analyze. While it is very difficult by means of traditional field investigation.

Android [5] is currently leading the mobile intelligent terminal segment in terms of market share since its introduction in 2007. In this paper, we implement our mobile application on Android tablets. Android tablets are portable and rich featured. Moreover, with android tablets, it is easy to standardize data format, simplify complex data recording, alleviate burden of personnel working in field, avoid the troubles to reinput data into files. Meanwhile, we could integrate GPS tracks, photos, videos etc. with collection data.

The structure of this paper is organized as follows. In the first section, we give an introduction to the study background, including the status of mobile intelligent terminals and analysis on traditional field data collection. In the second section, we describe the mobile application design. In the third section, we detail the implementation of the mobile application. In the fourth section, we give a summary of this mobile application. In the last section, we look forward the future work of this mobile application.

2 Mobile Application Design

As mentioned in the first section, an integral lifecycle of traditional field data collection compose four steps. The first one is analyzing data collection needs and designing data collection forms; the second one is collecting data in field, including observation data such as species of wild animals and plants, position data, environment data, and multimedia data such as photos and videos; the third one is data arrangement, including collecting all paper forms, inputting data into files, checking validation of data, and modifying obvious errors of data; the last one is data process, including integrating multisource data, making statistical reports, and providing visualization display.

In order to improve the traditional field data collecting method, we need to adopt more intelligent, automatic, efficient techniques. We will convert paper data collecting forms into electronic format files and display them on tablets. Users carry out data collection and store data on tablets. Data collected by tablets will be transmitted to background servers over mobile Internet. While data process can be executed on high performance background servers instead of tablets.

Figure 1 shows the architecture of the mobile application. The Mobile application is running on android tablets to implement data collection. It is capable to communicate with background servers to upload and download data through mobile Internet.

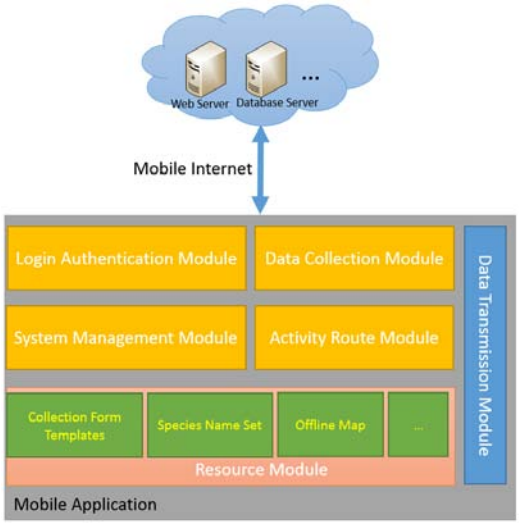

Figure 1. Application Architecture

In this paper, we focus on the first three parts which processed by android tablets. The mobile application running on Android tablets is composed of different modules. Following we will introduce each module.

2.1 Resource Module

Resources of this mobile application include collection form templates, species name sets, and offline maps etc.

In order to record data on Android tablets, we should convert paper collection forms into electronic format firstly. In this mobile application, we call the electronic format of collection forms as template. We design templates with XML technology [6]. Requirements of different field investigation correspond to different templates. In each template, it defines the specific attributes of every item. The attributes include the item name, data type of item value, length of item value, whether can be empty, etc. For the item with limited candidate values, such as species names, we will attach a resource provider to the item which usually a text file or XML file. Figure 2 shows an example of a template.

```
<?xml version="1.0" encoding="UTF-8"?>
<xml>
    <title>Mamal Investigation Form</title>
  - <item>
        <key>time</key>
        <name>Time</name>
        <attribute>datetime</attribute>
        <value/>
        <empty>0</empty>
        <display>1</display>
    </item>
  - <item>
        <key>species</key>
        <name>Species</name>
        <attribute>varchar(100)</attribute>
        <value>provider:mamalnamedirectory.txt</value>
        <empty>0</empty>
        <display>1</display>
    </item>
  - <item>
        <key>sex</key>
        <name>Sex</name>
        <attribute>varchar(10)</attribute>
        <value>Male,Female,Unknown</value>
        <empty>0</empty>
        <display>1</display>
    </item>
</xml>
```

Figure 2. Template Example

Resource module also includes offline map which used by activity route module. It is usually out of network access in field. Although with network connection, it will cost a lot of network traffic to load map and will take a long period which will affect users' experience. In this mobile application, users can download the map of the region he will execute field data collection before they go outside. The mobile application can instantly load the background map without any network connection.

In resource module, users are able to manage the resources, such as importing a new template, deleting an existing template, modifying specific name directory file, downloading new offline map, etc.

2.2 Login Authentication Module

On the one hand, only authorized user is permitted to access the mobile application. On the other hand, the data collected in the field is a very important original data for research and environment protection, so it is necessary to guarantee traceability of data. So mobile application have to authenticate the validity of users. In consideration of the situation without network access, user can login to the application as a visitor. He could record data into template. While at the time he uploads collection data, he has to pass the login authentication. Of course, the mobile application also provides registration function to users.

2.3 Data Collection Module

Data collection module will load qualified template chosen by users and generate the collection form interface automatically. The generation of interface is compatible to different screen size. With the data collection interface generated from a template, user can record data in the interface. For data fields of time, longitude, latitude, and altitude, the application will automatically fill them in. For the fields with specific values, especially for the complicated name of species, the application will show the candidates in a list for user to choose. We provide fast indexes for user to select the target item quickly. For photos, user can directly take

photos by Android tablet instead of recording sequence numbers of photos which will take extra time to find the corresponding photos.

2.4 Activity Route Module

Activity route module provides user with the function to track his activity route. In most applications, GPS tracks functions are simply record a series of GPS points. In our mobile application, we integrate text description, photos, audios and videos with GPS tracks. During the field investigation, user can add a key point where he observes some animals or some plants. With the function of adding a key point, he can input some words to descript this spot. In consideration of convenience, he also can record a piece of audio instead of typing words. Moreover, he can attach photos or videos to a key point to reflect the situation of the spot in details. The format of GPS activity route file conforms to KML [7] standard and can be loaded into Google Earth directly. Through GPS tracks, we could know about the details of the investigation carried out. In this mobile application, we correlate observation data with GPS tracks. From investigation data, user can find out a specific record obtained from which point of the correspondent GPS tracks and vice versa.

2.5 System Management Module

System Management Module provides the function to set data storage directory, check new version of software, chose to send feedback or not, etc.

2.6 Data Transmission Module

When a field data collecting activity is finished, user can save the collection data and activity route on the Android tablet. The application labels these data as un-uploaded. At this phase, users are permitted to modify the data. Then they can upload these data to the remote server through the network of mobile carriers or WIFI. After that, the application labels these data as uploaded. Users could only view these data on mobile terminals, but couldn't modify them.

3 MOBILE APPLICATION IMPLEMENTATION

The development environment of this mobile application is as follows:

- Windows 7 32 bit
- JDK1.7.0_45
- Eclipse Luna SR2(4.4.2)
- Android SDK 22.3
- ADT 23

The mobile application requires Android version 4.0 or above.

During our test, we user Samsung Galaxy Note 10.1 2014 Edition P601 as the platform running the mobile application. The screen size of P601 is 10.1 inch and the resolution is 2560x1600. CPU is Exynos 5420 with 4 kernels manufactured by Samsung. Main frequency of CPU is 1.3GHz+1.9GHz. System memory is 3GB and the storage capacity is 32GB. Android version is 4.4.2.

Figure 3 shows the welcome interface of the mobile application. User can choose to login the mobile application or make configuration or learn about the introduction of the application.

Figure 3. Welcome Interface

Figure 4 shows the login interface of the mobile application. User can input his account and password to login the mobile application or register as a new user.

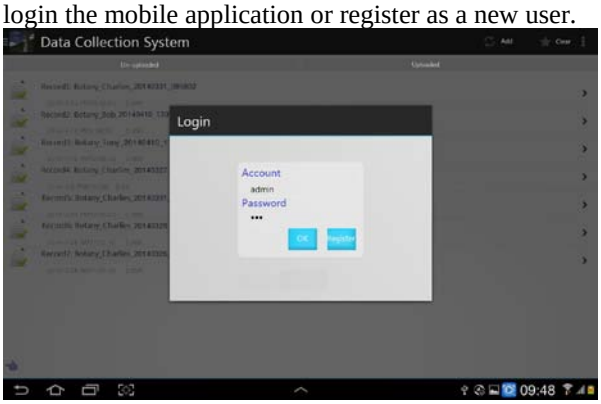

Figure 4. Login Interface

Figure 5 shows a data collection form interface generated automatically. In each data collection form, the mobile application provides the function to check the validation of each column and the integration of the whole form.

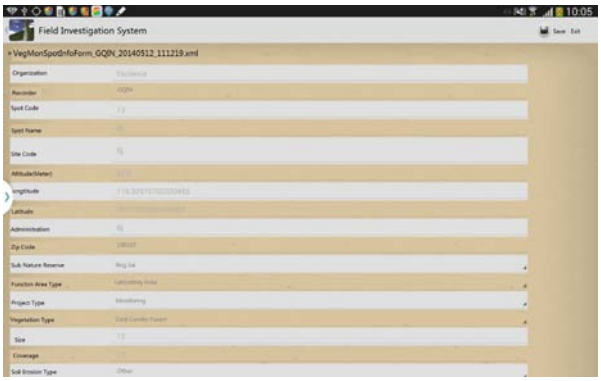

Figure 5. Data Collection Interface

In this application, we use Baidu Map APIs [8] to implement activity routes display and other map related operations. Figure 6 shows an activity route with key points attached with photos.

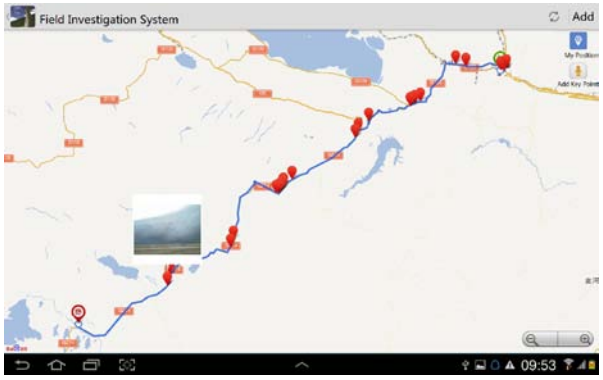

Figure 6. Activity Route

4 SUMMARY

In this paper, we introduce a mobile application for data collection. In our implementation, we develop this mobile application on android tablets. The mobile application on tablet can import field data collecting template and generate collection interface automatically. During data collection, it also will record activity route. Both field collection data and activity route will be stored on tablets. Users can upload these data to server through mobile Internet, including the network of mobile operator and WIFI.

5 FUTURE WORK

Currently, we have implemented filed data collection by Android tablets. In fact, our design method can be transplanting to iOS based tablets.

Meanwhile, in order to mining the value of these original data collected by tablets, we still need to rely on computers which are more powerful. We will develop web applications to implement data analysis and visualization next step.

Many field data collecting jobs are carried out in minority areas and by minority people. For the popularization of our mobile application, we need to develop this mobile application to support Multilanguage, such as Tibetan language, in the future.

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