Developing a Tracking and Mobile Mapping System

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Abstract– **In the past, positioning, tracking, mapping and navigation depend largely on astronomical observations that consist of measuring position of the sun or particular stars. Thus, orientation of any line or position - latitude, and longitude - of point can be determined. On the other hand, field observations of the relative positions of points can be plotted and oriented to produce a map. Map can also be produced directly by plotting referenced positions of measured points. Today, these techniques are no longer be used. This is so, because astronomical field procedures and computations are difficult and time consuming. Moreover, Global Positional System (GPS) makes these operations simple and saving time. In this research work, tracking and mobile mapping system was developed. This system allows continuous observation of coordinates using GPS receiver. These coordinates are then either transmitted in a stream mode automatically through android streamer or sent point by point, to a web page including a satellite image covering the target area. Thus observed points can immediately be appeared in the computer monitor. These points can then be saved as track or map. The developed system assists to track vehicles or peoples at a distance. Moreover, maps can be remotely produced.**

Index Terms– **Android, GPS, Mobile Mapping and Tracking**

I. INTRODUCTION

MAP can be defined as a graphical representation of geographical setting. Maps especially designed to serve the needs of navigators are called chards. On the other hand tracking is the observing of persons or objects on the move and supplying a timely ordered sequence of respective location data to a model. Mapping and tracking are incorporated today in one system. This system is the Global Positioning System (GPS) which is a constellation of 24 well-spaced satellites that orbit the Earth and make it possible for people with ground receivers to determine their geographic location. GPS equipment is widely used in science and has now become sufficiently low-cost so that almost anyone can own a GPS receiver.

GPS devices determine their position by receiving radio signals broadcast from the GPS satellites orbiting above using three-dimensional trilateration technique. The device figures out its distance from three or four different satellites in the network, and then calculates its own position using this information.

II. TYPES OF TRACKING DEVICES

GPS tracking devices come in two different types, active tracking devices and passive tracking devices. Active tracking devices (Real time tracking), have the ability to track positioning data and to then broadcast that data in real time. Passive tracking devices (Static) are essentially one-way GPS receivers that do not have the ability to broadcast any information. These devices instead, collect positioning data and store it on their internal memory. When the unit is collected and linked to a computer, it is then possible to download and analyze the tracking data that it has collected.

III. SOFTWARES

Mobile tracking system can be developed by integrating number of functions and procedures developed in number of computer packages. Such as:

i. *Dreamweaver:* is a program to design web pages, in addition to its shape and attractive professional editor that provides a suitable environment for the development of web pages in a neutral for the different browsers and different web programming languages. It helps programmer to color the text in different codes to facilitate tick, as the discovery of errors in the code design.

ii. *PHP:* is a general-purpose server-side scripting language originally designed for Web development to produce dynamic Web pages. It is one of the first developed server-side scripting languages to be embedded into an HTML source document, rather than calling an external file to process data. Ultimately, the code is interpreted by a web server with a PHP processor module which generates the resulting Web page. It also has evolved to include a command-line interface capability and can be used in standalone graphical applications. PHP can be deployed on most Web servers and also as a standalone shell on almost

every operating system and platform free of charge.

iii. *MySQL:* Is one of the most powerful languages to deal with databases, which facilitates the process of data management to view, add, or delete it by sending a query to the database.

iv. *CSS:* is a style sheet language used for describing the presentation semantics (the look and formatting) of a document written in a markup language. Its most common application is to style web pages written in HTML and XHTML, but the language can also be applied to any kind of XML document, including plain XML, SVG and XUL. This language is used to solve the problems of HTML and to provide a lot of time and effort to work as a web page or site.

v. *HTML:* Hypertext Markup Language (HTML) is the main markup language for web pages. HTML elements are the basic building-blocks of webpages. HTML is written in the form of HTML elements consisting of tags enclosed in angle brackets (like <html>), within the web page content. HTML tags most commonly come in pairs like <h1> and </h1>, although some tags, known as empty elements, are unpaired, for example <img>. The first tag in a pair is the start tag, the second tag is the end tag (they are also called opening tags and closing tags). In between these tags web designers can add text, tags, comments and other types of text-based content. The purpose of a web browser is to read HTML documents and compose them into visible or audible web pages. The browser does not display the HTML tags, but uses the tags to interpret the content of the page.

vi. *AJAX:* is a group of interrelated web development techniques used on the client-side to create asynchronous web applications. With Ajax, web applications can send data to, and retrieve data from, a server asynchronously (in the background) without interfering with the display and behavior of the existing page. Data is usually retrieved using the XML Http Request object. Despite the name, the use of XML is not needed (JSON is often used instead), and the requests do not need to be asynchronous.

vii. *JavaScript:* is a prototype-based scripting language that is dynamic, weakly typed and has first-class functions. It is a multi-paradigm language, supporting object-oriented, imperative, and functional programming styles.

viii. *jQuery:* is a free, open source software, dual-licensed under the MIT License or the GNU General Public License, Version 2. jQuery's syntax is designed to make it easier to navigate a document, select DOM elements, create animations, handle events, and develop Ajax applications. jQuery also provides capabilities for developers to create plug-ins on top of the JavaScript library. This enables developers to create abstractions for low-level interaction and animation, advanced effects and high-level, theme-able widgets. The modular approach to the jQuery library allows the creation of powerful dynamic web pages and web applications.

ix. *WAMP Server:* is an acronym formed from the initials of the operating system Microsoft Windows and the principal components of the package: Apache, MySQL and one of PHP, Perl or Python. Other programs may also be included in a package, such as phpMyAdmin which provides a graphical user interface for the MySQL database manager, or the alternative scripting languages Python or Perl. Equivalent packages are MAMP (for the Apple Mac) and LAMP (for the Linux operating system).

x. *Android:* is a Linux-based operating system for mobile devices such as smartphones and tablet computers. It is developed by the Open Handset Alliance, led by Google. It is used by several smartphones, such as the Motorola Droid, the Samsung Galaxy, and Google's own Nexus One. The Android Operating System (OS) is based on the open Linux kernel. Unlike the iPhone OS, Android is open, meaning developers can modify and customize the OS for each phone. Therefore, different Android-based phones may have different Graphical User Interfaces GUIs even though they use the same OS.

Android phones typically come with several built-in applications and also support third-party programs. Developers can create programs for Android using the free Android SDK (Software Developer Kit). Android programs are written in Java, which is optimized for mobile devices. Users can download Android "apps" from the online Android Market.

Fig. 1: Android

IV.   MEASUREMENTS AND RESULTS

The general idea of this work is to determine locations of points using either GPS navigator or an android phone then, transmitting the coordinates of these points in order to draw them on a web page at a distant.

A QuickBird satellite image of 0.6m resolution covering part of Khartoum state, including the college of engineering - Sudan University of Science and Technology - was used in this research work.

Fig. 2: QuickBird satellite image

This system was developed through number of steps including the following:

- Designing web page using Adobe Dreamweaver by inserting a satellite image covering the study area in a rectangle. This image represent a background on which observed points will be plotted.

- Georeference the satellite image. This step is important so as to make observed points to fit their correct positions in the background image. Georeferencing was carried out through selecting five well distributed points on the image. These points were then observed in the field using Garmin GPS Navigator to find out their coordinates. These coordinates were used to reduce transformation formulae for both easting and northing in which:

$$E_{1(meter)} = e_{1(Pixel)} \times 0.536877484 + 450350 \qquad (1)$$

$$N_{1(meter)} = n_{1(Pixel)} \times 0.45277986 + 1720635 \qquad (2)$$

Where,
E_1 and N_1 are the ground coordinate of the point,
e_1 and n_1 are the image coordinates of the point.

Equation (1) and Equation (2) above were programmed using Adobe Dreamweaver as shown in Fig. 3:

```
</script>
<script language="Javascript">
    $('#example2').mousemove(function(e){
        var x = (e.pageX - this.offsetLeft);
        var y = -1*((e.pageY - this.offsetTop) );
        var xmeter = (x * 0.536877484)+450350;
        var ymeter = (y * 0.452779869)+1720635 -((e.pageY - this.offsetTop)/20.50943396);
        $('#example2-xy').html("X : " + xmeter + " <br/> Y : " + ymeter );
         $("#example2-xy").css({left:e.pageX + 10, top:e.pageY + 10});

    });
</script>
```

Fig. 3: transformation function programmed using Dreamweaver

- Plotting position Signalization by creating a small box of 10×10 pixel using Dreamweaver to represent any observed point on background image. Observed point will then appear as a box in which a point number will appear inside. AJAX library code was used to do this step as shown in Fig. 4:

```
function Ajax(){
var xmlHttp;
    try{
        xmlHttp=new XMLHttpRequest();// Firefox, Opera 8.0+, Safari
    }
    catch (e){
        try{
            xmlHttp=new ActiveXObject("Msxml2.XMLHTTP"); // Internet Explorer
        }
        catch (e){
            try{
                xmlHttp=new ActiveXObject("Microsoft.XMLHTTP");
            }
            catch (e){
                alert("No AJAX!?");
                return false;
            }
        }
    }
xmlHttp.onreadystatechange=function(){
    if(xmlHttp.readyState==4){
        document.getElementById('dots_div').innerHTML=xmlHttp.responseText;
        setTimeout('Ajax()',5000);
    }
}
}
```

Fig. 4: AJAX code to represent observed point

- Designing curser coordinates indicator on the screen. This was achieved by designing a box located at a distance of 10 pixels right of the bottom of the mouse cursor to represent continuously the cursor location at any time. Fig. 5 demonstrates this step.

```
#example2-xy{
    height: 50px;
    width: 200px;
    position: absolute;
    z-index: 99;
    border: medium solid #FFFF00;
    font-size: 16px;
    font-style: normal;
    color: #FFFF00;
    font-family: Arial, Helvetica, sans-serif;
    text-decoration: blink;
}
body {
    background-color: #CCC;
}
```

Fig. 5: Curser coordinates indicator

- In this work, two options were suggested for data entry. Manual data entry; in which coordinates of points entered

numerically point by point using the keyboard and automatic; in which GPS determine the coordinates ant then transmitted by android.

In manual method an entry page needs to be designed and programmed. Entry page was created by Dreamweaver. It contains two text fields. The first named X, in which easting coordinate of point should be entered where the second Y field for entering northing coordinate. These coordinates can be determined by GPS navigator and then entered numerically in the required fields. Fig. 6 demonstrates the page entry code designed using Dreamweaver.

```
<div align="center">
    <dl>
        <dt class="style3">please, insert X and Y to get your location !    </dt>
    </dl>
</div></td></tr>
<tr>
  <td> <div align="right"></div></td>
  <td><label for="textfield2"></label>
  <div align="center" class="style2">
      <div align="center"><span class="style3">X</span>
      <input type="text" name="txtX" id="textfield2" />
      </div>
  </div></td>
</tr>
<tr>
  <td> </td>
  <td><label for="textfield3"></label>

      <div align="center"><span class="style3">Y</span>
      <input type="text" name="txtY" id="textfield3" />
      </div></td>
</tr>
<tr>
```

Fig. 6: Page Entry code

- Saving coordinates in a database form. PHP page was designed to bring coordinates of points and save them in a database table. Fig. 7 shows the code of this step.

```
<?php
mysql_connect("localhost","root","");
mysql_select_db("project_db");
$x=$_POST['txtX'];
$y=$_POST['txtY'];
if($y=="" or $x=="")
echo "missing value";
else
{
$test=mysql_query("insert into coordinates values ('NULL','$x','$y')");
if ($test==1)
echo "data inseted";
else
echo "ERROR";
}
?>
```

Fig. 7: Page saving code

- To read entered and saved data above, a code written again with Dreamweaver was used. This code page also transforms ground meter coordinates to web page pixel coordinates using equation (3) and equation (4) below as represented in Fig. 8.

$$E_{(Pixel)} = \left(E_{(meter)} - 450350\right)/0.536877484 \qquad (3)$$

$$N_{(Pixel)} = \frac{\left(N_{(meter)} \times 20.50943396 - 35289249.9\right)}{10.28625882} \qquad (4)$$

```
<?php
mysql_connect("localhost","root","");
mysql_select_db("project_db");
$sql=mysql_query("SELECT * from coordinates");
$counter=1;
while($row=mysql_fetch_array($sql))
{

$xpx=($row['x']-450350)/0.536877484;
if($xpx<0)
$xpx=0;
$ypx=(($row['y']*20.50943396-35289249.9)/10.28625882);
?>

<div class="dot" style="margin-left:<?php echo floor($xpx);  ?>px;margin-top:<?php echo floor($ypx);  ?>px;" ><?php echo $counter;
?></div>

<?php
$counter++;
}
?>
```

Fig. 8: Read data code

- By completing a particular job using this application it may be necessary to clear old data and state a new project. To do this, a particular button was designed for the purpose of deleting points on the screen and starts the tracking process again. This button is a written order within a logical page that was created by Dreamweaver PHP format; to remove all the contents of the table coordinates when needed.

```
<?php
mysql_connect("localhost","root","");
mysql_select_db("project_db");
$c=mysql_query("TRUNCATE table coordinates");
header("location:main.html");

?>
```

Fig. 9: Page clearing code

- The automatic data entry method was also proposed and designed here utilizing the ability of Android system to send data automatically mobile GPS coordinates directly to the application. Therefore, the system will be more flexible and automatic tracks or maps can be produced.
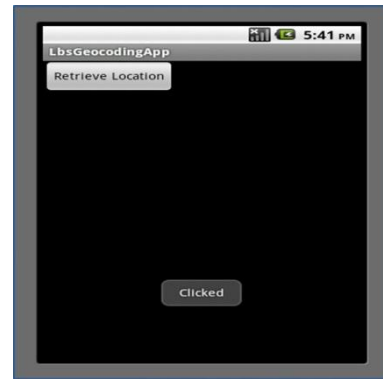

Fig. 10: Android application

When the application is opened, the working mobile GPS will directly determine the point coordinates. This coordinates is then converted first to the map system coordinates using PHP Page converter. Then, converted coordinates are transmitted by android to the system application. Finally the system will display coordinates -received from Android- on

the map display page to be plotted as a track points or map point.

By completing this application, all pages of the work were arranged in one folder in the WAMP server, so that to execute the required functions and to process input data.

Fig. 11 shows an entry page interface- programmed in the server and the Lamb- including a background image with two boxes in which operator has to enter both X and Y coordinates of the required point and press (GO) button. Hint statement was also added.
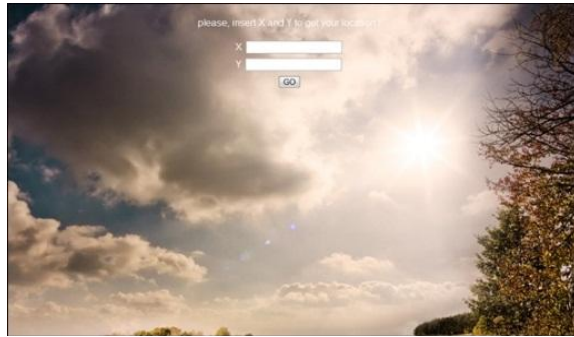

Fig. 11: Entry page interface

Entered coordinates should then be stored in an intermediate page (Save Page) in a database table including three fields: id, x and y which stand for serial number of the point, easting coordinate and northing coordinate successively. Table 1 shows sample test data.

Table 1: Entered coordinates saved in database table

id	x	y
1	450728	1720610
2	450346	1720550
3	450765	1720360
4	450687	1720130
5	450420	1720080

Stored coordinates are then read by (Read Data Page) and displayed as a small box in the map with a serial number. Automatic point determination was also tested by the application using GPS. By pressing the particular button the coordinates should be transmitted by android phone and received on the web page to be displayed directly on the map. Fig. 12 shows number of tested points with their serial numbers.

Fig. 12: Result of tested data

V. CONCLUSION

At a distant point determination is required for both tracking and mobile mapping systems. This work incorporates two approaches in one system. Direct entry page and automatic one. Capabilities of android phone were utilized for both GPS coordinates determination and data transmission. From research work done and results obtained it can be concluded with the following:

- Low cost tracking and mobile mapping system can be developed utilizing internet service in which data can be entered in point mode. Moreover, android phone capabilities can be integrated in this system for real time mapping and tracking.

- Although data represented in image map but database table is also available.

- Maps can be developed directly at a distant so mapping time preserved.

- Although mapping accuracy depend on android phone GPS but, it is sufficiently enough for number of applications.

- At a distant tracking systems can be used for monitoring peoples, cars and trucks and civilian, military security services...etc.

- The developed system is simple and easy to operate moreover; additional features can be added when required.

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