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ONLINE MOBILE MAPPING APPLICATION DEVELOPMENT FOR MONITORING FRUIT TREE PLANTATION

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ABSTRACT

Data-collecting in packed fruit and beverages is one of the most important aspects in the progress of a region, let alone a country, so that they can monitor their harvest anytime through their fruit-producing-tree. Especially those in plantation resources, Indonesian fruit factories also providing the world's exports commodities. Thus, a good data collection is needed to monitoring every tree in the field. There are times when the data-collecting and monitoring of the harvest done before they're sent to the factory have errors due to the lack of suitable media interface in harvest monitoring. There exist a data-collecting and monitoring system by using satellite images but it has a flaw: satellites can't give detailed information about the variety of the plants, they can only provide the images about whether the plant exists in the field or not. Based on this issue, the writer provide a solution in the form of GPS technology using GPS Tracking Method, Google Maps API, MySQL Database, Java and Code Igniter combined in an Online Mobile Mapping Application. This application can provide data of each trees coordinates in a field belonging to the factory where every data inputted by each of the farmers working for the factory, such as the result of the harvest, regularly updated status of every tree, all of that stored inside MySQL database that can be monitored in the form of Google Maps Interface. With this application development, the factory will be aided to ascertain the growth or history of harvest, number of trees in the field, and directly monitoring every tree in their field. This application may also providing the information of strategic location to the fruit processing industries chief so that he can build a factory that is efficient in transporting and so on.

Keywords: mobile mapping, GPS, monitoring, Google maps API, MySQL.

INTRODUCTION

The data collection for every commodity results are different each year, that's why fruit harvest monitoring will come to the aid in increasing the factory-product's quality in years to come. And this harvest will increase Indonesia's resources as one of the fruit provider in the export commodity aided by industry sectors so that the harvest can become one of the inland revenues.

Well-managed farm products can bring out various quality products that have high economic value, quality products such as palm, cocoa, rambutan, mango, durian, and other farm products suitable for Indonesia land contour. As an agricultural land, farming sectors may come to aid in both providing job offers and increasing the countries devisa in terms of exporting Indonesia harvest products.

As seen in Figure-1, Indonesia's harvest quantity for each commodity is enormous, so a data collecting and monitoring application is needed in the industry.

We can use the current technology to provide for data collecting and monitoring, such as Google Maps, launched in 2005 to provide online mapping service that can be downloaded from a server in a form of client - server communication (Peterson, 2008).

Other than using Google Maps is to manually collecting data of every tree by inputting each of the tree's coordinates in the field by using GPS. Each tree's tracked coordinates will be using satellite-based GPS navigation system which provide the location, time and other information in kinds of weather, anywhere on Earth, each latitude presented using one or more GPS satellite. This GPS (Global Positioning System) technology has also been applied in cell phones and smartphones (Muthumurugesan *et al*., 2013).

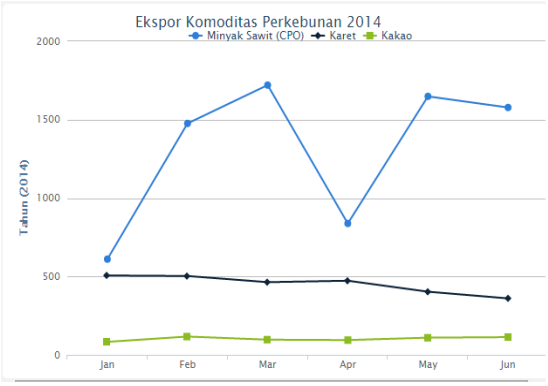

Figure-1. Indonesia's 2014 plantation commodities export statistics (source: Ministry of Agriculture Plantation Directorate General of Indonesia).

GPS and Google API is one of the system in the developed application, considering the developers have been implementing Google Maps API in form of web-based mapping service out of simple application by showing only the dots combined with some sophisticated technology called "map mashup" (Johnston *et al*., 2009),

(peng *et al*., 2010), (Roth *et al*., 2009), (Chow *et al*., 2008).

Map mashup is focused on the usage of data and sending service data according to the coordinate of the trees. The purpose of this study is to track every tree owned by the farmers where the results are shown inside a data server from an advanced interface that can monitor every tree inside the field, including its mutation.

LITERATURE REVIEW

A case study in the form of a map or known as Geographic Information Systems (GIS) in observing the harvest of fruit-bearing trees has also been done by Tarik where the GIS was positively upgraded to create a better, efficient, and immune products by using a fast parameter in GIS logging (Tarik, 2012).

Apart from that, GIS application in evaluating a field has also been done Son and Rajendra whose study about GIS data building that were used was a special data and the habitant's economic data so the components in designing the GIS was more thorough so the given information may help in relocating the field(N.T Son dan Rajendra, 2008).

Out of Tarik and Son's case study, the data that were used was an on field data in establishing a mapping system so that the development of advanced stage system that the writer is planning is mobile mapping system plan to directly monitoring the condition of each farmer's fruit-bearing trees.

The stage of making an online mapping study is actually not as new as the case made by Padmaja and Upendra whose case was about web mapping as a process of designing, implementing, and delivering maps in the World Wide Web. This study provides a map for users to search and browse special information, such as location and route (Padmaja and Upendra, 2009). The research conducted by Padmaja is comparing virtual earth and google maps in terms of online mapping where the results of the data shows that the best performance in online map usage is to use Google Maps and security techniques.

The use of Google Maps API V3 provides a highly efficient mechanism for delivering digital mapping informations to the internet users with a fast response time and user-friendly-interaction. The use of Google Maps has several map-types control such as roadmap or satellite imagery (Shunfu and Ting, 2013).

Web-based GIS application can show how Google maps is integrated with Google Earth in which the data is stored in the form of a database and it can be accessed so that the provided information is to accordance to the user's needs (Akanbi and Agunbiade, 2013).

Broadly speaking, the increase in application system development utilizing Google Maps API as a web application or the whole existing previous research only used the already existed information inside the database so there needed for an application where the already-tracked data via android smartphone and the monitoring is done through data server yet still remain in a joined server. This study is made to prove to be good for the fruit processing industry in monitoring the data of the tree in their fields, tens, thousands and even millions of trees were observed in one data server centre.

SYSTEM DESIGN

The design of this online mapping application system is to use some technology that is mobile technology, database, along with the data monitored directly by using a server owned by the landlord (the industry). This online mapping system begins with tree-tracking using a smartphone, continued by inputting the trees data according to each farmer so the incoming data in accordance with the managing farmers who will later be reported to the landlord, or in this case, the industry. The next stage after the data has been inputted is to observe the data in the form of Google Maps interface done by the head of the industry.

The concept of this application is seen in Figure-2, it explains that the application combines mobile technology, java, and along with the PHP programming language in the Code Igniter framework. When desktop Mobile Mapping want to be accessed by the user, the application initializes monitor pages in the form of online maps, where the application sends a request to Google Maps to loading the data in the form of maps_container.php (see below). maps_container.php script will ask for each plants data inside the database to be loaded and marked in the Google Maps according to its coordinates in the form of latitude and longitude. Every tree that has been marked in the map has its own different latitude and longitude where the GPS tracking is done using smartphone and wait for the GPS to get locked well.

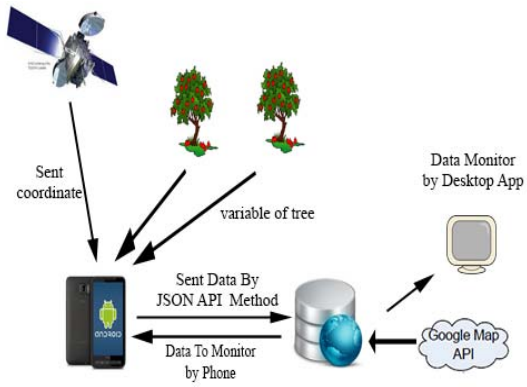

Figure-2. Architecture system.

The data set for this application development contains thousands of the field's data, including the name of each tree, type of saplings, landlords address, regions, districts, cities, usernames, passwords, and geographic locations of each tree that is obtained from GPS tracking

(latitude and longitude) for each tree in the field owned by the farmers.

METHODOLOGY

GPS Tracking Through Java Programming

To make the application be able to track the coordinates inside this mobile mapping application, the writer uses mobile device access script set in the android Java script. GPS tracking script is useful in catching the target location's coordinates sent to the MySQL database server.

The location coordinates is a represented in the form of latitude and longitude coordinate system. The latitude is defined as 0-90 degrees north or south of the equator and the longitude as 0-180 degrees east or west of the meridian, which passes through Greenwich, England. Altitude is represented in meters above sea level (Manav and Anupam, 2012).

```
public Location getLocation() {
try {
locationManager = (LocationManager) mContext
.getSystemService(LOCATION_SERVICE);
// getting GPS status
isGPSEnabled = locationManager
.isProviderEnabled(LocationManager.GPS_PROVIDER);
// getting network status
isNetworkEnabled = locationManager
.isProviderEnabled(LocationManager.NETWORK_PROVIDER);
if (!isGPSEnabled && !isNetworkEnabled) {
// no network provider is enabled
 } else {
this.canGetLocation = true;
// First get location from Network Provider
if (isNetworkEnabled) {
locationManager.requestLocationUpdates(
LocationManager.NETWORK_PROVIDER,
MIN_TIME_BW_UPDATES,
MIN_DISTANCE_CHANGE_FOR_UPDATES, this);
Log.d("Network", "Network");
if (locationManager != null) {
location = locationManager
.getLastKnownLocation(LocationManager.NETWORK_PROVIDER);
if (location != null) {
latitude = location.getLatitude();
longitude = location.getLongitude();} }}// if GPS Enabled get lat/long
using GPS Services
 (isGPSEnabled) {
if (location == null) {
locationManager.requestLocationUpdates(
LocationManager.GPS_PROVIDER,
MIN_TIME_BW_UPDATES,
MIN_DISTANCE_CHANGE_FOR_UPDATES, this);
Log.d("GPS Enabled", "GPS Enabled");
if (locationManager != null) {
location = locationManager
.getLastKnownLocation(LocationManager.GPS_PROVIDER);
if (location != null) {
latitude = location.getLatitude();
longitude = location.getLongitude();
                }
            }
        }
       }
    }
 }
```

Code Snippet-1. Tracking data algorithm from device with java programming.

JSON API Programming Java

After tracking with GPS for every tree in the field, next one is to create a tracking data delivery and other input system into the database where the data transmission process is done with JSON Parser API as can be seen in Figure-3 below:

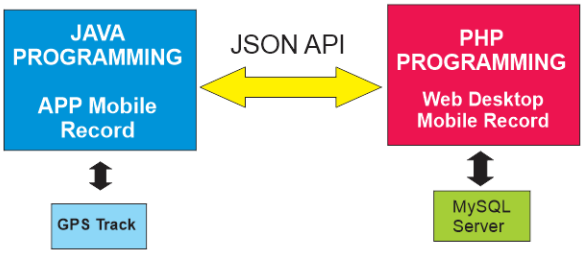

Figure-3. Application data transmission flow.

JSON Parser API is a data exchange medium between smartphone's GPS tracking device with a data server that has the MySQL data storage format. JSON Parser API is used to hold the entire data variables obtained through smartphone applications.

```
public JSONObject postValue(String u, String p, String lat,String lng){
// Building Parameters
List<NameValuePair> params = new ArrayList<NameValuePair>();
params.add(new ("nama_tanaman", u));
params.add(new BasicNameValuePair("jenis", p));
params.add(new ("id_pemilik", MainActivity.UID));
params.add(new BasicNameValuePair("lat", lat));
params.add(new BasicNameValuePair("lng", lng));
// getting JSON Object
JSONObject                                  json                                =
jsonParser.getJSONFromUrlPost(MainActivity.serverPath+"input_tanaman",
params);
// return json
return json;     }
```

Code Snippet-2. JSON API application from Java to code Ingniter framework.

Followed by the variable data stored in the form of JSON Object then the data is sent to the server based on the address of the **serverpath** so the sent data is in accordance to the web server address.

API Receiver Path Server

Once the data has been transmitted from the mobile application through JSON API Java, the data is then processed in accordance with the existing serverpath in PHP programming route.

```
/*API*/
$route['api/login'] = 'api/login';
$route['api/register']= 'api/register';
$route['api/get_jenistanaman'] = 'api/get_jenis_tanaman';
$route['api/input_tanaman'] = 'api/input_tanaman';
$route['api/get_listtanaman'] = 'api/get_list_tanaman';
$route['api/input_status'] = 'api/input_status_tanaman';
$route['api/statistik'] = 'api/statistik';
$route['api/maps'] = 'api/maps';
```

Code Snippet-3. API route receiver path with.

Code Ingniter Framework

Based on the route created in php programming server, the call of the appropriate process route server that is similarly used as the data storage inside the MySQL database during the process of the plant's input in the field.

```
<?php
class Api_model extends CI_Model {
 /**
   * Responsable for auto load the database
   * @return void
   */
public function __construct()
{this->load->database();   }

function input_data_tanaman($data)
{$insert = $this->db->insert('data_tanaman', $data);
return $insert;    }

function input_data_status_tanaman($data)
{$insert = $this->db->insert('status_tanaman', $data);
return $insert;    }

function register($data)
{$insert = $this->db->insert('membership', $data);
return $insert;    }

function update_product($id, $data)
{$this->db->where('id', $id);
$this->db->update('products', $data);
$report = array();
$report['error'] = $this->db->_error_number();
$report['message'] = $this->db->_error_message();
if($report !== 0){
return true;
}else{
return false;       }
}

function delete_product($id){
$this->db->where('id', $id);
$this->db->delete('products'); }
}
        ?>
```

Code Snippet-4. API function with code Ingniter framework.

"Mashup" of Google Maps API and MySQL Database through Code Igniter Framework

Mobile mapping application is a system that has a web-based desktop and mobile android, each API Maps implementation is put in PHP programming-shaped Code Igniter Framework where each coordinate data is stored in the form of a query loaded from MySQL database. MySQL database server is used to store the data due to its high performance machines, the ability to insert the data very fast, and the strong support for specialized web functions such as fast full text search (Khondker *et al*., 2009).

Just like the data models drawn from each database, every positions are marked based on the data coding script calling done by initialization function and displayed in the form of interface model as seen in a piece of script code snippet-5.

```
<head>
<script type="text/javascript"
src="http://maps.google.com/maps/api/js?sensor=false">
</script>
<script type="text/javascript">

function initialize() {
var position = new google.maps.LatLng(<?php echo $data_tanaman[0]['lat'].','.$data_tanaman[0]['lng']; ?>);
var myOptions = {
zoom: 15,
center: position,
mapTypeId: google.maps.MapTypeId.ROADMAP };
var map = new google.maps.Map(
document.getElementById("map_canvas"),
myOptions);
<?php
$a=0; foreach($data_tanaman as $location){            ?>
var location = new google.maps.LatLng(<?php echo $location['lat']; ?>,
<?php echo $location['lng']; ?>);
var image = '
<?php echo base_url(); ?>
assets/img/marker/
<?php echo $location['nama_jenis_status']; ?>.png';
var marker
<?php echo $a; ?> = new google.maps.Marker({
position: location,
map: map,
icon: image,
title:"
<?php echo $location['nama_jenis']; ?>"      });
var contentString
<?php echo $a; ?> = '<?php echo '<b>'.$location['nama_tanaman'].'</b><br>'.$location['nama_jenis_status']; ?>';
var infowindow
<?php echo $a; ?> = new google.maps.InfoWindow({
content: contentString<?php echo $a; ?>
});
google.maps.event.addListener(marker<?php echo $a; ?>, 'click', function() {
infowindow<?php echo $a; ?>.open(map,marker<?php echo $a; ?>); });
          <?php $a++;} ?>
}
</script>
</head>
```

Code Snippet-5. Function marking from database with code Ingniter framework.

RESULT AND DISCUSSIONS

Tracking process, data registering and monitoring in the form of mapping is the core of this study. This mapping application has multiple application interfaces that originally began with the process of the register. The database can be collected from application online registration process through the mobile mapping application, so that the landlord's data can be recorded in the database whether it's the name, address, region, province, phone number along with the username and password used to log each of the farmers in when tracking for trees in their own field, as can be seen, each users must register in advance according to the format in Figure-4.

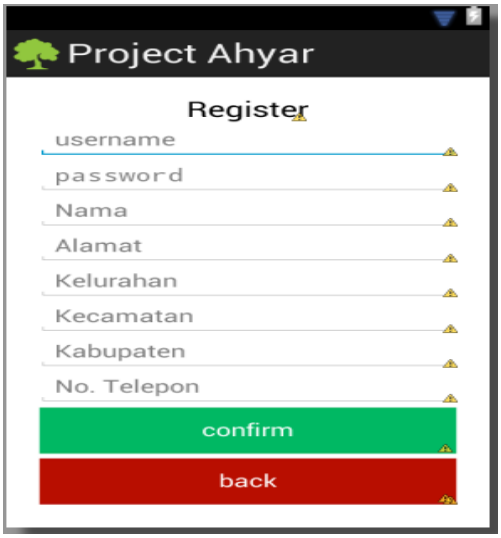

Figure-4. Form register to record the farmers profile before tree data tracking.

Users may use the application after they register, the user may initiate its tree tracking directly by simply pressing the round green button with the refresh symbol that will be running the tracking process using mobile devices which in this case, android smartphone like Figure-5. Coordinate tracking when pressing the refresh button will generate the coordinate data which will be sent to the MySQL database server.

To find out the level of accuracy of the GPS, several trials were conducted to compare the distance between the position recorded by GPS and the actual position between trees. GPS accuracy measurements were conducted on the field where there're trees in it, the input that is used were coordinates data and differences between the distances from the tree.

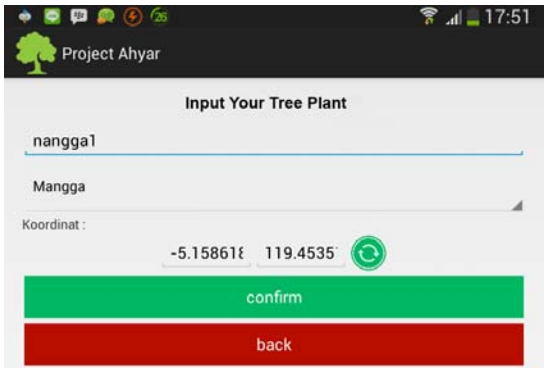

Figure-5. Tracking tree with GPS application.

Table-1. GPS accuracy test results.

No.	Dates of Trial	Recorded Coordinates	Distance using GPS (Meters)	Actual Distance (Meters)
1	2015-03-26 11:10:04	-5.244571, 119.859608	12	±13
2	2015-03-26 11:15:14	-5.244528, 119.859715	14	±16
3	2015-03-26 11:117:34	-5.244478, 119.859797	20	±23
4	2015-03-26 11:20:14	-5.244458, 119.859859	30	±31
5	2015-03-26 11:40:14	-5.244425, 119.859952	40	±43
6	2015-03-26 11:50:04	-5.244704, 119.859652	50	±52
7	2015-03-26 12:00:04	-5.244647, 119.859749	60	±61

Based on the GPS accuracy results, it can be concluded that the level GPS accuracy that was generated has a difference of 1-3 meters where the differences are due to several factors such as the number of existing satellites tracking to provide the coordinates data, number of the bts in internet data transmission, device processing speed and other factors. But of these tracking results we can draw a conclusion that every tree has been inputted into the database that then will be monitored via a map as in Figure-6 and Figure-7.

Figure-6 also displays the interface of map model view that was enlarged so that the coordinates of the marker can be seen. The users can click the marker icon to get the specific information about the corresponding tree in the field when the application displays a Google Info Window that becomes the map monitor of the existing tree in the field.

In Figure-7, it shows in satellite view so that the form of the marked tree can be instantly seen in satellite imagery. The tree markers also give an indication of the state of the tree that are represented according to its icon shape along with its color so that the user can understand better the condition of the tree in his field, let alone the users who monitor the trees in the area.

CONCLUSIONS

This paper has shown that a recording online mobile application that was developed using Google Maps API v3, java android, MySQL database server, and PHP developing language using the Code Igniter Framework. Case studies was represented in this study provide sophisticated functionality for displaying the location, number of trees, featuring and online mapping by showing the status of every tree in the field either in units, tens, even thousands of trees that will later be recorded into MySQL database server.

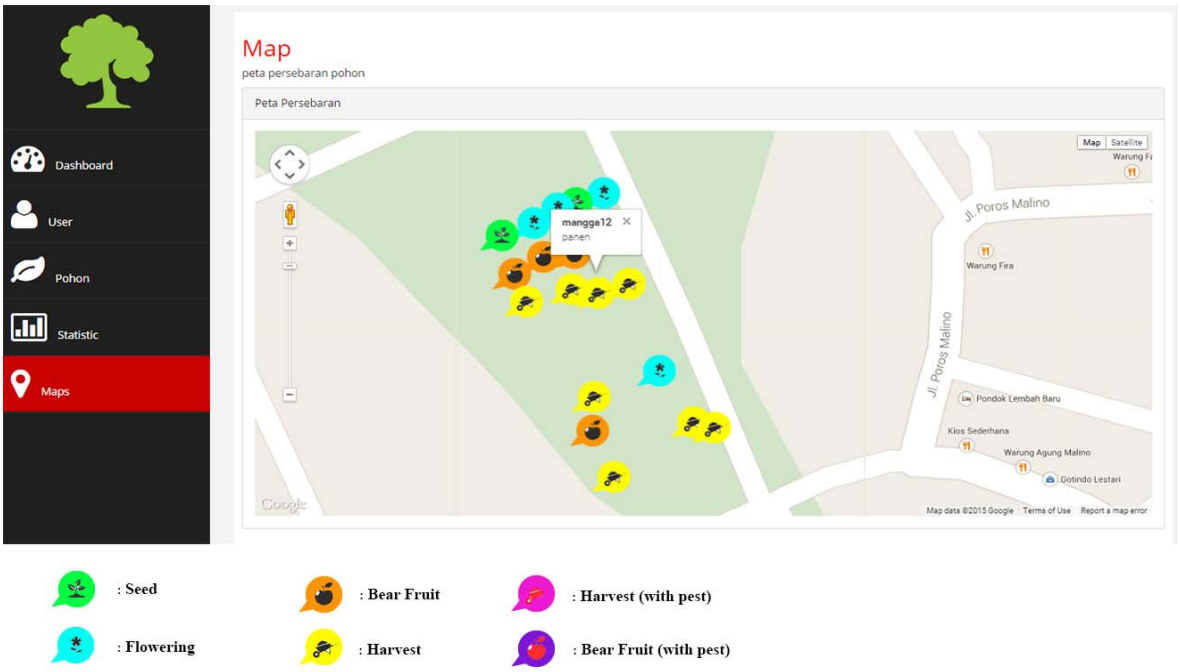

Figure-6. Tree monitoring mobile desktop application record with maps model.

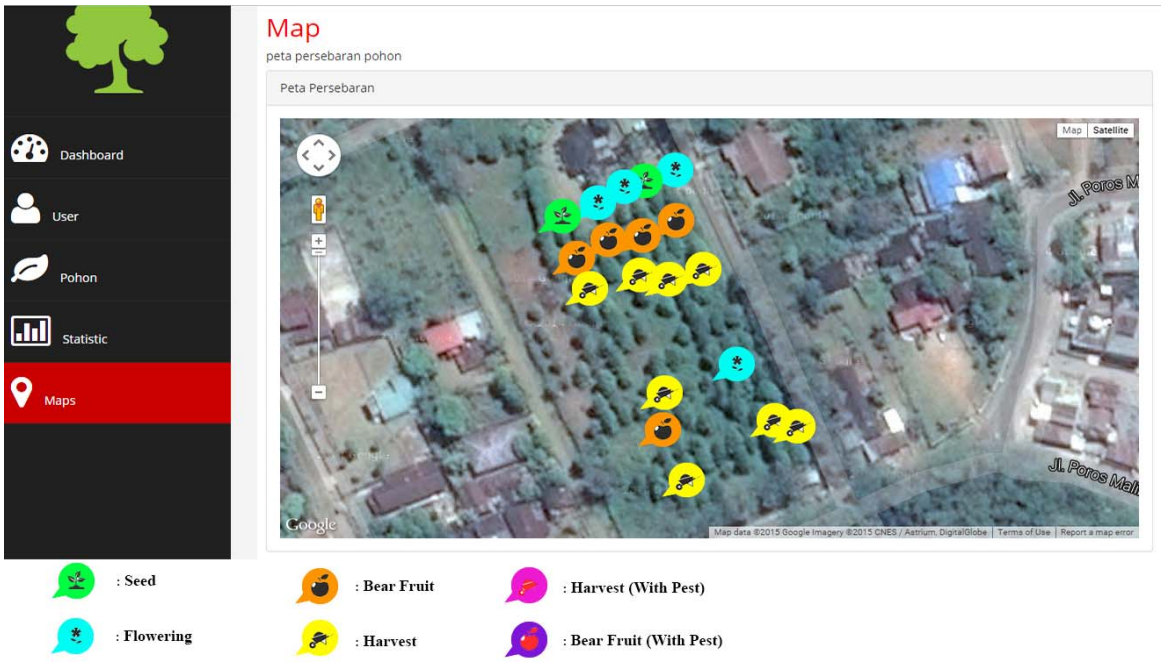

Figure-7. Tree monitoring mobile desktop application record with satellite view model.

API v3, java android, MySQL database server, and PHP developing language using the Code Igniter Framework. Case studies was represented in this study provide sophisticated functionality for displaying the location, number of trees, featuring and online mapping by showing the status of every tree in the field either in units, tens, even thousands of trees that will later be recorded into MySQL database server.

First, the database can be collected from application online registration process through the mobile application either fill in data such as landlord's name,

address, city, username and password, along with the user's phone number.

Second, each registered users logged into the system can do the tree tracking inside the field in accordance with its respective tree containing information about the data coordinate latitude and longitude.

Third, after the data has been collected and stored, the application then will process the data according to the records in MySQL and Code Igniter script to call the Google Maps function in accordance with the coordinates in the database to be marked along with the adjustment of the tree's condition.

Fourth, the backend database can be updated via the interface in mobile application so that the tree status data can be directly changed real-time which can be seen on the desktop application. The information and geo-spacial data sharing becomes an important and trending thing for the development of various applications. So that with the existence of this system, the fruit industry would be helped, especially in recording their fruit-bearing trees inside their field, knowing a strategic position for plantation industry development to avoid the cost of the process of transporting the harvest, and monitoring the growth of existing trees or infected tree in their field directly by using this system.

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