

# **e-Map as An Android Application Using Shortest Path Algorithm**

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## **ABSTRACT**

Using a mobile device, the user could access the map application anywhere you go. The study was developed to determine the best path from one location to another using GPS Satellite. It has three features: Searching, Detecting, and Logbook. The user can input the starting location and destination anywhere on land through searching using the Shortest Path Algorithm. Based on the inputted location given by the user, the list of available routes will be determined which enables the user to select one from a set of possible routes. Afterward, the application will detect which path that the user will take to reach their destination applicable anywhere in the world through GPS satellite. It identifies the current location of the person and once the user moves from his current location to another location, the GPS will update every 20 seconds so that all possible routes with the number of kilometers will give the user to choose the shortest route. After the completion of the Google Map application, it was found out that this application can be used worldwide. It can detect routes anywhere in the world by using arrays (from JSON) as data provided from the satellite as long as travel is on land.

**Keywords** – Information Technology, Google map, mobile application, shortest path algorithm, JavaScript Object Notation, Philippines

## **INTRODUCTION**

How would the user arrive at his destination in the shortest distance possible? Using a mobile device, the user could access the map application anywhere you go. Even though an advanced application like Google Map has provided almost everything about location, there are still limitations on this application that will be addressed by this study. That is, the researchers developed a new application and which is the “e-Map: An Android Application using Shortest Path Algorithm”. The researchers developed this application through the use of mobile not only

because it was the most trending scenario but also it has the ability to access from anywhere you go. The application would notify the user all the possible routes and upon the choice of the user, destination will be highlighted by the green path.

The features of this project were the following: provide all the possible routes to a destination, detect which path was the shortest by determining the number of kilometers, provide the user the choice route from source to destination, and provide the details based on what direction you had chosen as well as latitude and longitude of the location. eMap can be used worldwide as long as it is a land travel and will provide a picture of the location for easy access. The programming languages used were Java and XML.

Implementation of the Google Map according to Pan, Crotts and Muller (2007) is the big evolution of the static map from Letowsky (2004) as a representation that was used before by humans. It can provide interactive mapping services as well as realistic satellite images. By using this dynamic map, the people will no longer analyze the charts by themselves. The application will notify the user to show the shortest distance possible using Dijkstra's algorithm as suggested by Yan (2015).

## FRAMEWORK

**Maps.** According to Letowsky (2004), a map is a 2D depiction of the wide distribution of objects. For instance, a map may display the location of rivers, cities, or mountain ranges in a particular region. Most maps are plain, making their storage, production, and handling relatively simple. Maps present information to the observer at a diminished scale. They use mathematical relationships to maintain geographic relationships between points and are smaller than the area they demonstrate. Maps represent information by using legends or symbols. In addition to this, based on the source of Merriam-Webster, a map is a representation usually on a flat surface of the whole or a part of an area.

There are many different types of maps in the present generation based on their concepts, features, and how to use them. For this research, we will cover only two kinds: the Online Map and the Google Map. Regarding the relationship of these two, they are quite equal but some of them have their particular concepts.

Based on the journal by Goetz et al. (2012), online maps are necessary tools and data sets, such that, maps are usually provided by commercial providers or public authorities. Online map, according to Rouse (2006), is also a compilation and

publication of Web sites that provide exhaustive graphical and text information in the form of maps and databases

**Google Maps.** Google Map is a desktop and mobile web mapping service application that allows you to display maps on your website. It can provide interactive mapping services as well as realistic satellite images as pointed out by *Crotts et. al., (2007)*

Based on the research by Zavlavsky (2015), the graphics of Google Map is now vector-based, not pixelated. It uses direct vector rendering in a browser to create highly interactive virtual maps from distributed sources of geographic data. It became possible with the advent of XML (eXtensible Markup Language) and XML applications for 2D vector rendering such as VML (Vector Markup Language) and SVG (Scalable Vector Graphics).

The relationship of Online Map and Google Map is that they are both stored in the Internet system or World Wide Web. Without this system, then both of these will not be possible. Anyone could manage the Online Map while Google Company could control the Google Map. Among all the available online maps recently, Google Map is the most advanced mapping system.

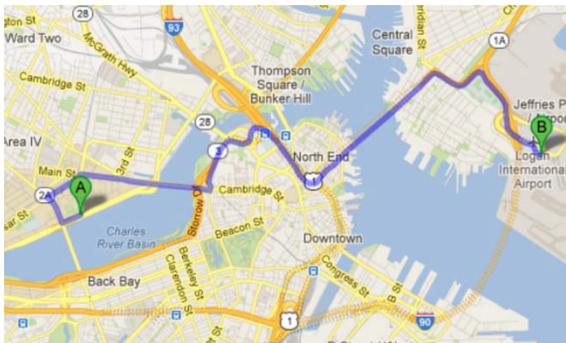


Figure 1. Online and Google Map  
Source: <https://www.google.com.ph/maps/>

An algorithm is a logical arithmetical or computational procedure that if correctly applied ensures the solution of a problem. It is also a recursive method whereby it generates an infinite sequence of terms (Collins, 2016).

According to the study of Lozano, et al (2008) “the combination of Google Earth™ and free GIS software (e.g. HealthMapper, developed by WHO, and SIGEpi, developed by PAHO) has tremendous potential to strengthen overall

public health capacity and facilitate decision support system approaches to prevention and control of vector-borne diseases in resource-poor environments” and this was also feature in the Bulletin of World Health Organization. This principle is in harmony with the study of Angelou (2010) in which Street View serves millions of Google users daily with panoramic imagery captured in hundreds of cities in 20 countries across four continents. Also, there is a team of Google researchers who describes the technical challenges involved in capturing, processing, and serving street-level imagery on a global scale.

Patterson (2007) established that Google Earth’s utility is a teaching tool in pre-collegiate environments as illustrated through development of a South Carolina-based lesson plan focused for seventh grade students that increases students’ geographic awareness while also building critical thinking, analysis, and inquiry skills in support of various educational standards.

**Dijkstra’s Algorithm.** According to Yan (2014), Dijkstra’s Algorithm is the solution to the single-source shortest path problem in graph theory. Based on the research by Climaco (2003), a Shortest Path Algorithm is one of the well-known algorithms that is used to represent a distance between a predetermined pair of nodes in a given network. The requirements are the following: Both directed and undirected graphs, all edges must have nonnegative weights, and graph must be connected.

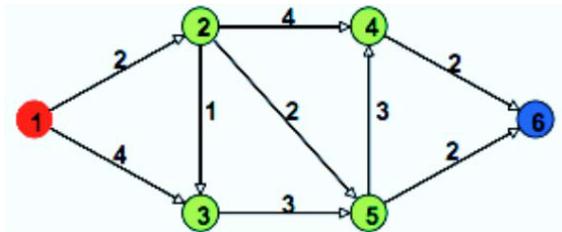


Figure 2. Shortest Path Algorithm

The uses of shortest path algorithm are to reduce the number of generated non-dominated paths during the search process by using a multiple-criteria shortest path approach when link travel times follow normal distributions. This algorithm is applicable for optimal truck routing through given traffic congestion pattern.

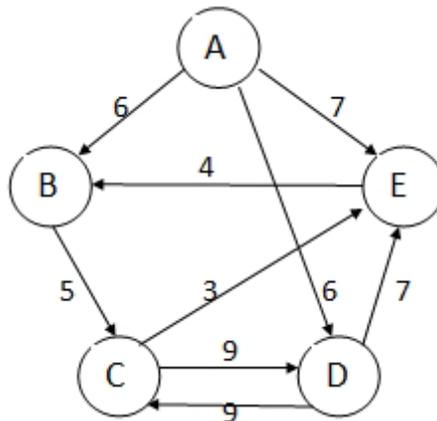


Figure 3. Shortest Path Diagram

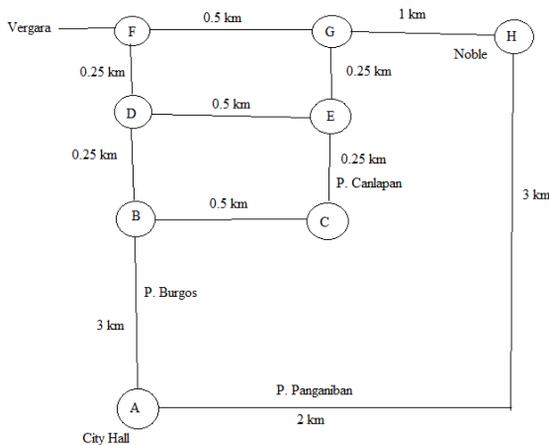


Figure 4. Graphical presentation of the application Dijkstra's Algorithm

How to detect the location? According to Zahradnik (2015), we can identify the location by using a GPS or Global Positioning System. GPS analyzes, gathers, and saves location data from its weak satellite signals, operates the location information, then transmits it in real time or saves the data for review later.

GPS tracking devices need to have access to the open sky through the need

to get a signal to the cellular network often and to capture satellite signals. For instance, getting a signal indoors don't work well.

Based from the research by Vargas (2008), a command of control can then be communicated via a mobile communication network that initiate one or more locate service functions, such as wipe data from a memory of the device, lock the device to disable device features, and/or transmit a GPS location signal, as well as overriding configuration settings of the device. The locate service of the device can also receive the location signal of the GPS, communicate the location of the device for display, and determine a location from the GPS signal.

How GPS works? Integrated Mapping Ltd (2015) discusses about how GPS works, that is, GPS uses a lot of complex technology, although the concept is simple.

From each GPS satellite, the receiver gets a signal. When the signals are sent the satellites transmit the correct time. The signal was transmitted from the time it was received by subtracting it which can tell by the GPS how far it is from each satellite. The receiver also knows the correct position in the sky of the satellites, at the moment they sent their signals. So given their exact position in the sky and travel time of the GPS signals from three satellites, the GPS receiver can find out your location in three dimensions – north, altitude, and east.

The GPS receiver needs to identify the time very accurately in order to calculate the time the GPS signals took to arrive. Atomic clocks keep very precise time which the GPS satellites have it, whereas it's not feasible to equip a GPS receiver with an atomic clock. However, it can solve an equation that lets it determine the exact time if the GPS receive uses the signal from a fourth satellite.

You can still get your position if the GPS receiver is only able to get signals from satellite. Unfortunately, it will be more inaccurate. As we discussed above, the GPS receiver is necessary to have four satellites to work out your position in three dimensions. The GPS receiver can get an approximate position by making the assumption that you are at mean sea level if only three satellites are available. If you are at a mean sea level the location will be reasonably precise. However if you are in the mountains, the two dimensional fix could be hundreds or thousands of meters off.

A recent GPS receiver will track all of the available satellites. However, only a selection of them will be used to calculate your location.

On the other hand, an Android operating system based on the research by Anderson (2009) is a mobile operating system (OS) based on the Linux Kernel that was built to take advantage of touch screens. It can run on many different devices. It is also the world's best-selling Smartphone platform.

According to Melanie Haselmayr, there are 12 steps or processes in building a mobile application. The steps to consider are the following: (1) define your goal; (2) start sketching; (3) research. In researching, there are four sub-steps that you should follow. First, find out whether there are other apps doing the same thing. Second, find design inspiration for your app. Third, find information on the technical requirements for your app. Lastly, identify how you can market and monetize your app. Afterwards, (4) create a wireframe and storyboard. (5) Define the back end of your app. (6) Test your prototype. (7) Build a back end of your app. (8) Design the “app” skins. (9) Re-test. (10) Continue and revise to build. (11) Refine each detail. Lastly, (12) release your application.

## **OBJECTIVE OF THE STUDY**

The study aimed to develop a mobile application using Shortest Path Algorithm. It used GPS to detect the location and determine the best path between two points with the shortest distance.

## **METHODOLOGY**

For the effective visual approach and understanding of this program and documentation, the researchers used shortest path algorithm. It is one of the well-known algorithms that is used to represent a distance between a predetermined pair of nodes in a given network, as well as the Global Positioning System (GPS) to detect the actual location within the online map through the mobile application with Android Operating System. GPS is a satellite-based navigation system made up of a network of 24 satellites placed into orbit.

This algorithm helps the user to find a short distance between two points, which is the starting point and end point using GPS satellite which gathers, analyses and saves location data from its weak satellite signals, operates the location information, then transmits it in real time or saves the data for review later. The users input the source and the destination then the application will give some possible ways then it will show the highlighted green path considering that it is the best way to be taken. Highlighted red roads will be identified as the possible paths to reach the destination.

The researchers used Java as the programming language using the Eclipse IDE because it supports Android Application Development and has the capability to implement Google Maps on that IDE. The first step done is to insert the required

components in the graphic design using XML codes or drag and drop method. To edit a specific feature like sizes and padding in a particular Android constituent, add/edit/ remove some XML codes to apply changes. A Java code was created to add functionalities in the application. The existing AndroidManifest file was modified.

To create the initial point in our application, the programmer initialized the latitude and longitude value in the Java code. To determine the shortest path from the beginning point, the Google Map Road System was first activated in the user's Google account before inserting an appropriate formula for each path so that determining the shortest path will be possible.

To detect the location, the codes are the following:

```

LocationManager locationManager = (LocationManager)
getSystemService(LOCATION_SERVICE); Criteria cr = new Criteria();
String provider = locationManager.getBestProvider(cr, true);
Location location = locationManager.getLastKnownLocation(provider);
    if (location != null) {
        onLocationChanged(location);
    }
locationManager.requestLocationUpdates(provider, 200000, 0, this);
    centerLatLng = new LatLng(13.7637188, 121.0653556);
    ShowRoutes();
}

```

To compute the distance for available routes, the codes were listed below:

```

public void ListAvailableRoutes(String result) {
    List<String> items = new ArrayList<String>();
    lstRoutes = new ArrayList<Route>(); try {
        final JSONObject json = new JSONObject(result);
        JSONArray routeArray = json.getJSONArray("routes");
            for (int i = 0; i < routeArray.length(); i++) {
                JSONObject route = routeArray.getJSONObject(i);
                String via = route.getString("summary");
                JSONArray leg = route.getJSONArray("legs");
                JSONObject legZero = leg.getJSONObject(0);
                String distanceVal = legZero.getJSONObject("distance")
                .getString("text");
                items.add("Route " + (i + 1) + ": "
                + distanceVal + "(via " + via + ")");
            }
        }
    }
}

```

```

String removedKM = distanceVal.replace("km", " ");
removedKM = removedKM.trim();
double distance = Double.parseDouble(removedKM);
    if(nearestDistance > distance)
nearestDistance = distance; // to determine the shortest path
//start location
JSONObject startLocLatLang = leg.getJSONObject(0)
.getJSONObject("start_location");
String locLat1 = startLocLatLang.getString("lat");
String locLong1 = startLocLatLang.getString("lng");
//end location
JSONObject endLocLatLang = leg.getJSONObject(0)
.getJSONObject("end_location");
String locLat2 = endLocLatLang.getString("lat");
String locLong2 = endLocLatLang.getString("lng");
lstRoutes.add(new Route(i, "Route " + (i + 1), locLat1, locLong1, locLat2,
locLong2, distance));    }
        } catch (Exception e) {

Log.e("Fetch Error", "Error getting routes " + e.toString()); }

```

## RESULTS AND DISCUSSION

According to Gasimov (2010), the recent development in mobile technologies has increased the demand for sophisticated software applications for mobile devices. This technological-driven market evolution poses new opportunities and challenges for developers to create applications which will fully exploit mobile's new and expanding capabilities. Therefore, the study is an addition to a few available mobile applications, specifically, in finding location that can be downloaded for personal use.

To activate this e-Map application, the user will tap the e-Map icon on the phone's menu. Afterward, the main menu layout will appear on the screen. It contains three sub menus which are start, instruction, and logbook. When the user clicks the start button, it will display search activity.

The search feature allows the user to input the starting location and destination anywhere as long as it doesn't travel overseas. Based on the inputted location given by the user, the list of the available route will appear on the screen which

enables the user to select one of them. If the user chooses route one, it will display the color green path which represents the shortest distance possible to reach the destination. Otherwise, it will demonstrate the red color path which represents the possible way to reach the destination.

The application has four steps to follow and three legends. It is also considered user friendliness in the design.

Logbook feature is an advantage for those who have no internet connection. It shows the list of the previous location offline. How to add the venue in the logbook? Once the user taps the show route button after he inputted the starting location and destination in the search activity, it will automatically save his location into the logbook.

## CONCLUSION

After the completion of this Google Map application, it was found out that this application can be used worldwide. It can detect routes anywhere in the world by using GPS specifically using LocationService (from Google Satellite) as data provided from the satellite as long as travel is on land. Lastly, the application enables the user to choose which route is better in terms of shortest distance expressed in kilometers to reach their destination in the shortest possible distance.

## TRANSLATIONAL RESEARCH

The researchers recommend the study for travelers who need a guide using a dynamic map. The researchers also recommend this application to drivers and commuters to help them in reaching their destination in the shortest distance possible. To be able to use this application without encountering any errors, the researchers recommend the use of Android version 2.3 or higher with an Internet connection.

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## APPENDIX

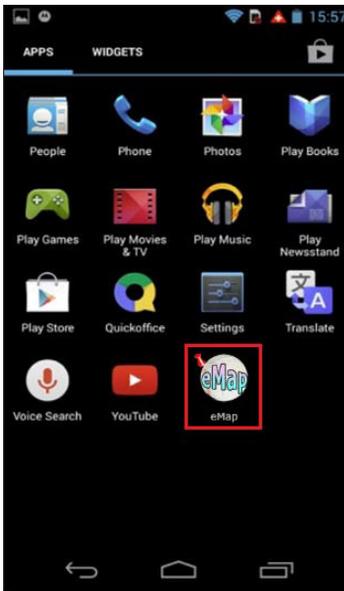


Figure 5. e-Map Application icon



Figure 6. Main Menu Screen

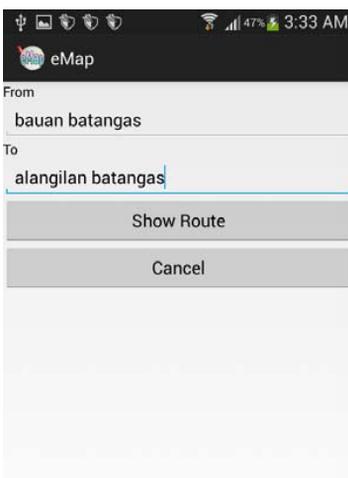


Figure 7. Search Activity

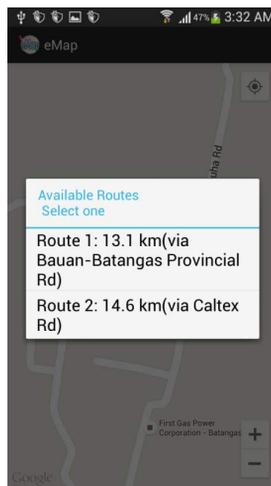


Figure 8. List of available routes

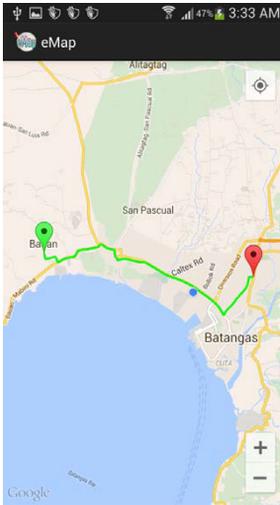


Figure 9. Result for shortest path

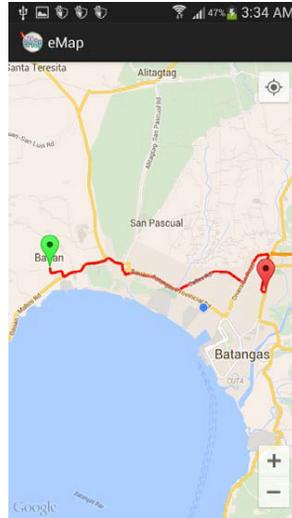


Figure 10. Result for possible path

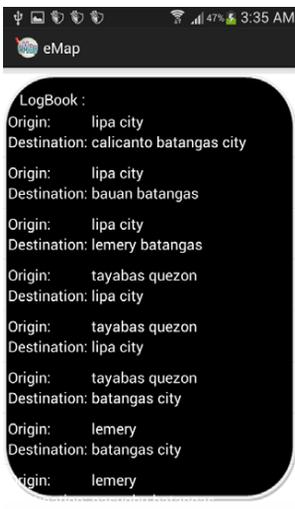


Figure 11. Logbook

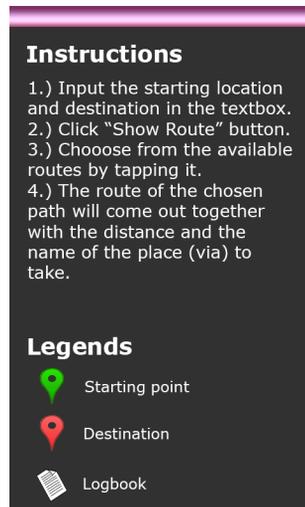


Figure 12. Instructions