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Framework for Data Mining In Healthcare Information System in Developing Countries: A Case of Tanzania

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Algorithm To Identify Location Of Incidents In Public Buses And Respective Nearest Authority Using Spherical Cosine Rule

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Abstract: Reporting the incidents to authorities in developing countries that can take actions has been a chaotic and slow process. This paper proposes an algorithm for a system that automatically reports events that compromise passengers' safety to respective authorities by using spherical cosine rule. When an incident such as an accident, over speeding or overloading of passengers occurs the system identifies the closest police station. It does so by calculating the shortest distance between latitudes and longitudes of the place where the event occurred and those of the closest police station. Then it identifies the next police station which the bus will encounter and where the event can be reported and immediate action carried out. The public buses will be equipped with GPS which will generate coordinates and there will be a database which contains the coordinates for the police stations along the main roads.

Keywords: Latitude, Longitude, GPS, GSM

INTRODUCTION
An algorithm is a procedure to accomplish a specific task. An algorithm is the idea behind any reasonable computer program. An algorithm is a procedure that takes into account any of the possible input instances and transforms them to the desired output[1]. Path similarity represents that many of the alternative paths derived from the k-shortest path algorithm are likely to share a lots of links, so they could not represent heterogeneity. The algorithm builds new path based on the degree of overlapping between each path and travel cost, and stops building when the degree of overlapping ratio exceeds its criterion[2]. This work has been done when we were developing a system for monitoring and reporting excessive passengers in public buses. The system detects when there is any event that compromises passengers' safety such as overloading of passengers, over speeding or accidents and reports it to the concerned authorities. It then sends report to the next police station the bus will come across so they can take necessary actions. This study was conducted along Arusha to Dar es Salaam road in Tanzania. Eighteen different police stations were identified where report can be sent. Each station has a mobile number where the messages are sent. The public buses equipped with GPS which identifies its location and GSM which sends the coordinates to a database.

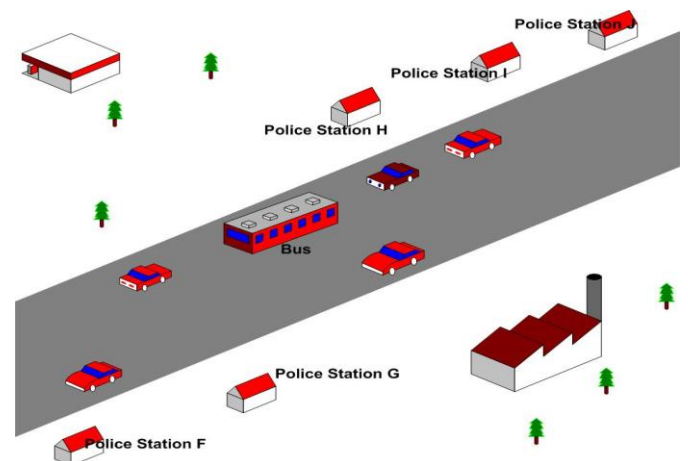**Figure 1:** Arusha to Dar es salaam road (source: Google earth)

Figure 2: Block diagram depicting different police stations along the road and the bus.

The Spherical law of cosines is used to spot the location of a police station closest to a public bus that has encountered an event such as accident, overloading of passengers or over speeding. This formula is used generally for Computing great-circle distances between two pairs of coordinates on a sphere[3]. Now to identify the location of the bus and where to send the report we invented an algorithm which can perform that task. To do this we have to know the three important parameters.

- Route
- Shortest distance
- Nearest police station

We have different types of structures for algorithms. All have associate algorithm problem. This includes Trees, Graph, Points, and String[4]. In our case we are dealing with points, latitude and longitude. Many branches of mathematics have contributed to aspects of algorithm design, and the issues raised by the analysis of new algorithmic problems have in a number of cases suggested novel mathematical questions[5]. The spherical cosine rule is used to calculate the shortest distance between the location the public bus and police stations.

ROUTE

Route is one of the important parameters for this algorithm. The first thing is to identify the route of the public bus. The next police station will depend on its direction. If it is from Dar es Salaam to Arusha the next police station is different as when it is from Arusha to Dar es Salaam. Therefore before doing anything identification of the route is indicated and stored in the database. The database has the table for the route where it checks before identifying the nearest police station. The following is the geocode stored in the database for different police stations along Arusha to Dar es salaam Road. If the route is from Arusha to Dar the nearest police station will be in descending order from Geocode_ID 18 to 1 and if the Route is From Dar es salaam the next station will be in ascending order from Geocode_ID 1 to 18.

Figure 3: Police Stations along Arusha - Dar es Salaam road

SHORTEST DISTANCE

The shortest path analysis not only refers to the shortest distance in general geographic sense, but also extends to other measurements, such as time, cost, and the capacity of the line[6].GPS system can be used to get location which includes details like latitude, longitude and altitude values along with the timestamp details etc. it a free of cost service available to every individual[7] The following part is calculating the shortest distance. The location which will have the shortest distance is one closest to the bus. Therefore the report will be sent to the next station the bus will encounter to take action. The shortest distance is calculated by the spherical cosine rule. A spherical polygon on the surface of the sphere is defined by a number of great circle arcs which are the intersection of the surface with planes through the centre of the sphere. The cosine rule is the fundamental identity of spherical

trigonometry: all other identities, including the sine rule, may be derived from the cosine rule.

$$\cos a = \cos b coc + \sin b \sin c \cos A$$
$$\cos b = \cos c \cos a + \sin c \sin a \cos B \qquad (1)$$
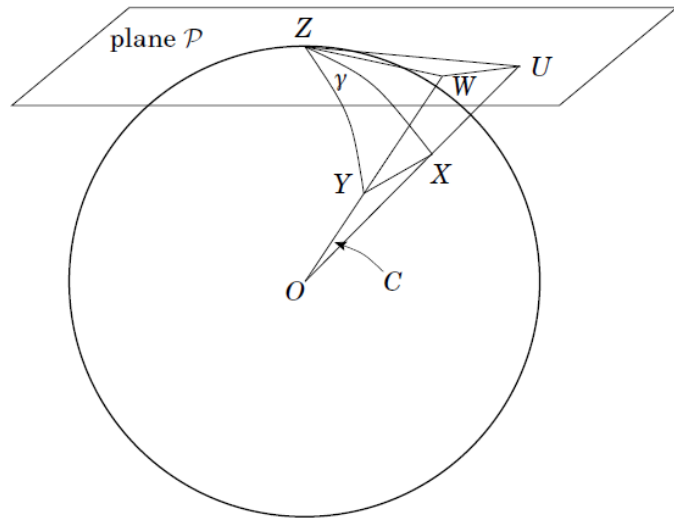$$\cos c = \cos a \cos b + \sin a \sin b \cos C$$

Figure 4: Different triangle on spherical shape

We next calculate the length of the segment UW in the plane P using the Euclidean Law of Cosines applied to the triangle UZW.
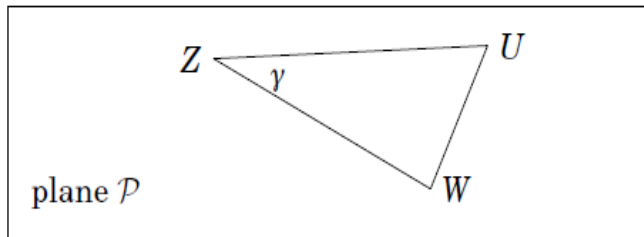

Figure 5: Triangle ZWU

First, we need the length of the segments ZU and ZW. The length of ZU can be calculated by looking at the cross section of the sphere containing O, Z, and U.
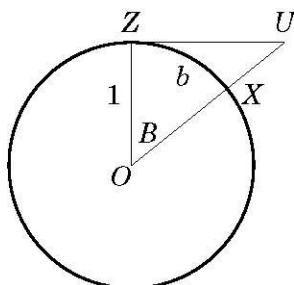

Figure 6: Triangle BZU

Hence, the length of ZU is tan B and similarly, the length of ZW is tan A.

Thus,

$$(Length of WU)2 = (length of ZU)2 + (lentoh of ZW) -$$
$$2(length of ZU)(length of ZW)\cos \gamma \qquad ..(2)$$
$$= (\tan B)2 + (\tan A)2 - 2(\tan B)(\tan A)\cos \gamma$$

Finally, we apply the Euclidean Law of Cosines to the triangle OWU. Note that the angle of UOW is C, which is our goal. First note that the length of OU is sec B from the above Figure, Similarly, the length of OW is sec A.

Thus,

$$(length of WU)2 = (length of OU)2 + (length of OW)2 -$$
$$2(lenth of OU)(length of OW)\cos C \qquad ..(3)$$
$$= (\sec B)2 + (\sec A)2 - 2(\sec B)(SecA)\cos C$$

Equating the two expressions for (length of WU)^2, we obtain,

$$(\tan B)2 + (\tan A)2 - 2(\tan B)(\tan A)\cos \gamma =$$
$$(\sec B)2 + (\sec A)2 - 2(\sec B)(\sec A)\cos C \qquad .... (4)$$
$$= (\tan B)2 + (\tan A)2 + 2 - 2(\sec B)(\cos A)\cos C$$

Where we used the Pythagorean identity $(\tan \theta)^2 + 1 = (\sec \theta)^2$ for the last step. Simplifying, we have

$$(\tan B)(\tan A)\cos \gamma = (\sec B)(\sec A)\cos C - 1, ... (5)$$

And cross-multiplying by (cosA)(cosB), we obtain

$$(\sin A)\cos B \cos \gamma = \cos C - (\cos A)(\cos B) .... (6)$$

Theorem (Spherical Law of Cosines)

$$\cos C = (\cos A)(\cos B) + (\sin A)(\sin B)\cos \gamma ....(7)$$

The Spherical law of cosines is used to find out the name of the device's location. Spherical law of cosines
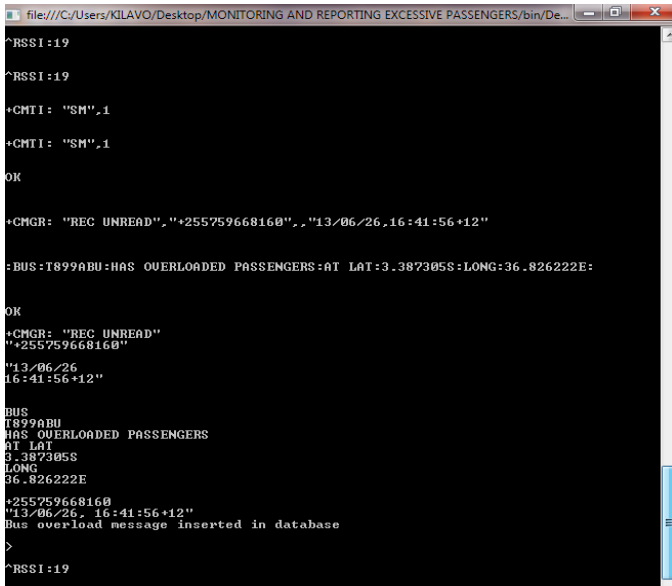
Figure 7: Latitude and longitude received from the system for the current location of the bus

$$d = R * a \cos 9 \cos(LA1) \cos(LAi) \cos(LOi - LO1) + \\ \sin(LA1) \sin(LAi)$$ …. (8)

Where

d =is the distance between two coordinates.

R=Radius of the earth.

LA1 = Latitude of the current location of the bus.

LO1 = Longitude of the current location of the bus.

(LA1 and LO1 as shown in figure 7)

LAi = Latitude of the location of all police station along the road.

LOi = Longitude of the location of all police station along the road.
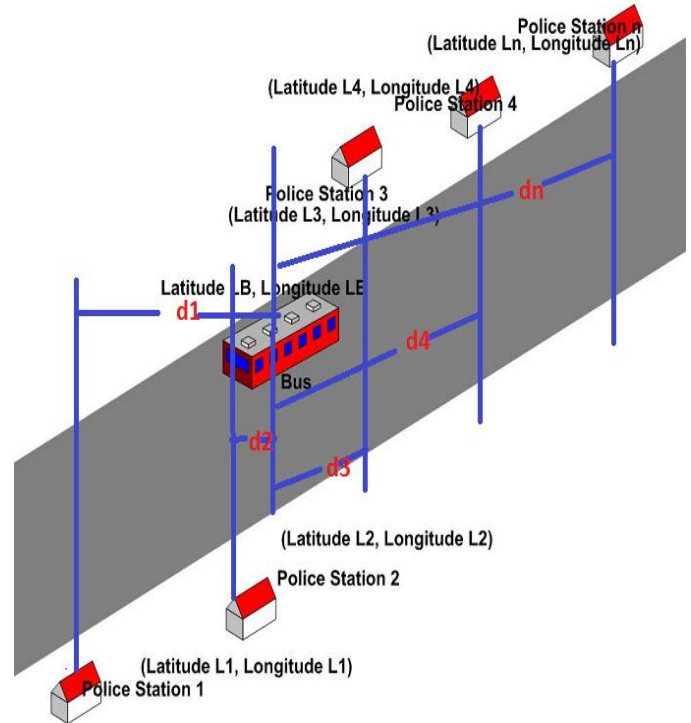
(LAi and LOi as shown in figure 3)

Figure 8: Different Station along the main road

NEAREST POLICE STATION

```
using System;
using System.Data;
using System.Data.SqlClient;
using System.Data.SqlTypes;
using Microsoft.SqlServer.Server;

//INITIALIZING STATION ARRAY
station[0] = DAR;
station[1] = KIBAHA;
station[2] = MLANDIZI;
station[3] = CHALINZE;
station[4] = WAMI;
station[5] = MKATA;
station[6] = SEGERA;
station[7] = KOROGWE;
station[8] = MOMBO;
station[9] = HEDARU;
station[10] = SAME;
station[11] = MWANGA;
station[12] = HIMO;
station[13] = MOSHI;
station[14] = BOMA_NGOMBE;
station[15] = KIA;
station[16] = USA_RIVER;
station[17] = ARUSHA;

//CALCULATING THE MINIMUM DISTANCE

for (i = 0; i < 18; i++)

{

    di = d = R * acos(cos(lat1).cos(lat2).cos(lng2 - lng1)
+ sin(lat1).sin(lat2));
```

```
        distance[i] = di;

        station = station[i];

    }

    minimum = distance[0];

    for (i = 0; i < 18; i++)

    {

        if (minimum > distance[i])

        {

            minimum = dist[i];

        }

    }

 //CHECKING THE NEXT POLICE STATION TO REPORT
THE EVENT

    if (Origin = DAR)

    {

        Station = Station[i + 1];

    }

    else if (origin = Arusha)

    {

        Station = station[i - 1];

    }
```

As discussed earlier, we need to identify the next police station to report the event. The code shows the first thing is to identify the route of the bus. The next step is to initialize the array for all the police stations along the road. Then calculate the distance from where the bus is located to the nearest police station. There after calculating the shortest distance then report to the next station for further action.

CONCLUSION

The paper demonstrates the calculation for the shortest distance from the location of the public bus to a nearest police station and one the bus will encounter next. Thereafter a report can be sent to both stations and proper actions can be put into effect. The algorithm has been tested on the 600 kilometers route from Dar es Salaam to Arusha in Tanzania for which the system was used for monitoring and reporting excessive passengers in public buses. The main objective was to identify the location of the bus where it overloaded the passengers and then send the report to the nearest police station for appropriate actions to be taken. The algorithm uses the spherical low of cosine.

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