

Estimating the Optimal Evacuation Routes for Emergency Events

Myint Myint Sein^{*}, Thin Lei Lei Thein^{*}, Mau Luen Tham^{**}
Y. Owada^{***}, N. Bin Ramli^{****} and S. Poomrittigul^{*****}

* UCSY, Yangon, Myanmar

*** NICT, Japan

***** PIT, Thailand

** UTAR, Malaysia

**** MIMOS, Malaysia

Disaster



Explosion, Fires, Crime

Accidents

s



Emergencies and emergency situations include wildfires, natural disaster Cyclone, Tsunami, strong wind, Earthquake It can be caused by explosions, etc.

In Myanmar, about 70% of natural disasters are fire.



Photo: A fire broke out at a warehouse storing backpacks on Thuzattar Road in Industrial Zone 2 in Dagon Suburban Township (MYSO)

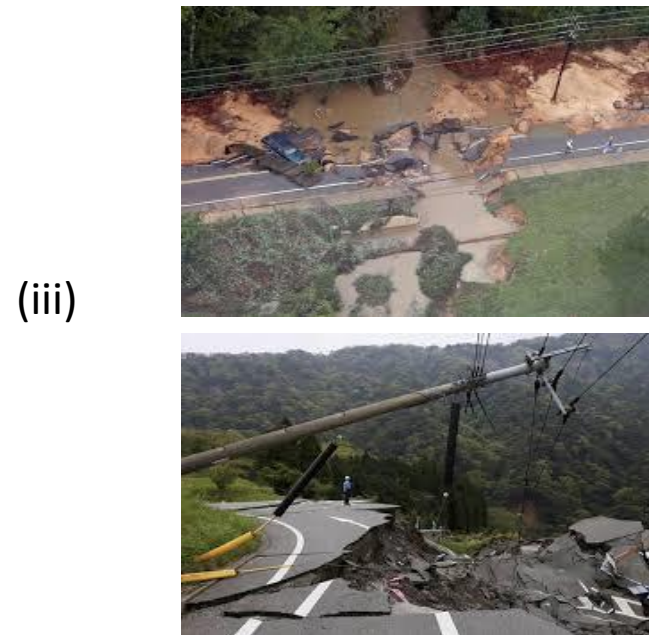
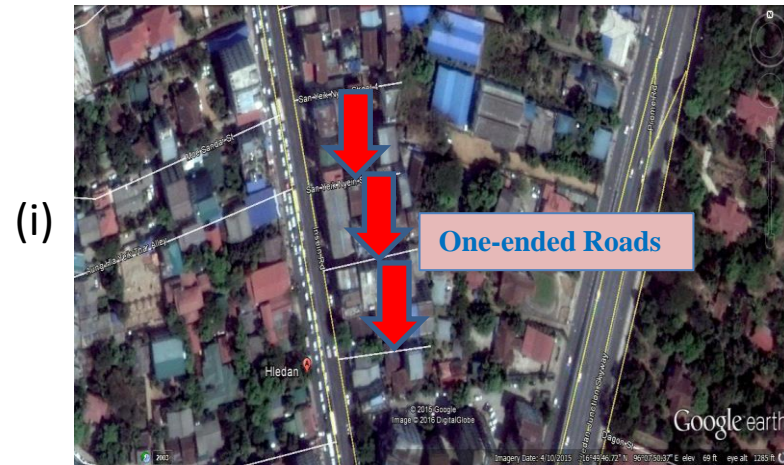
		outbreaks	Injured	Dead	Lost (million-kyats)	homeless
2021		2107	151	105	33000	4154
2022(Jan~ October)		1797	142	79	320643	6352
Kitchen	Negligence	Electric	arson	Forest	Others	
172	366	390	712	131	26	

Yangon:181 outbreaks of fire lost- 947 million

The metropolitan areas in Myanmar have the complex road network structure.

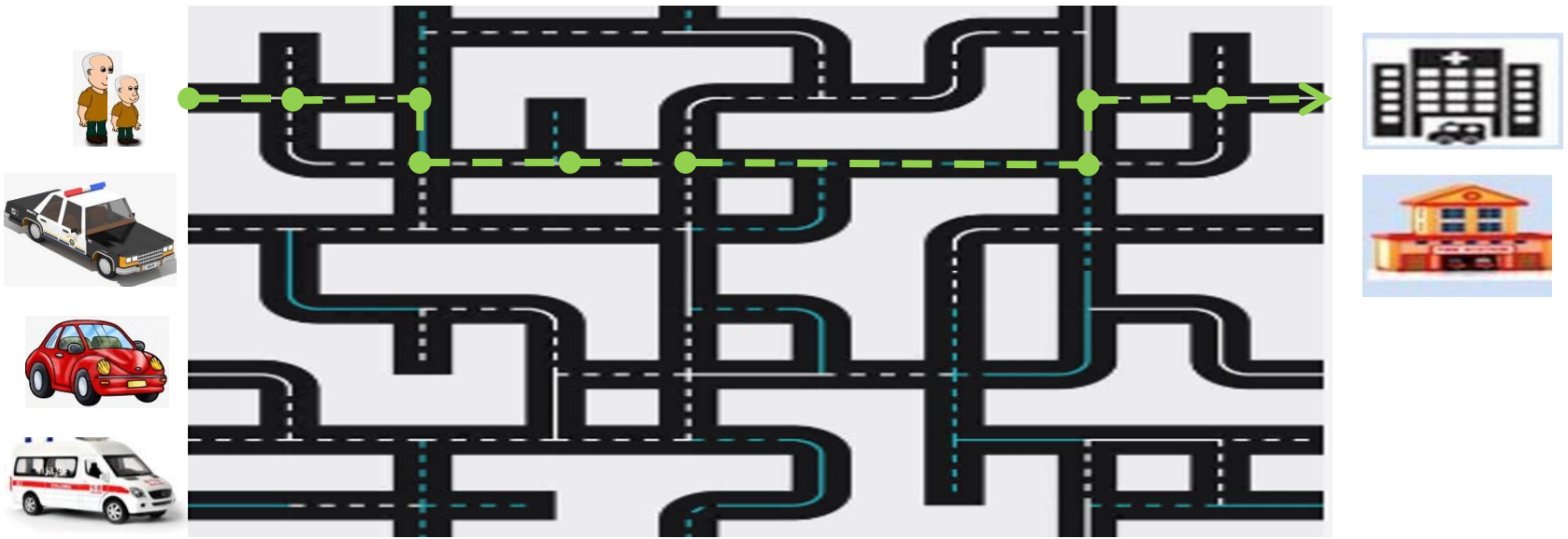
The complex structure road network can cause delay for drivers and can increase damage level.(e.g.. Close, narrow and blocked roads)

Some Problems of Road Network

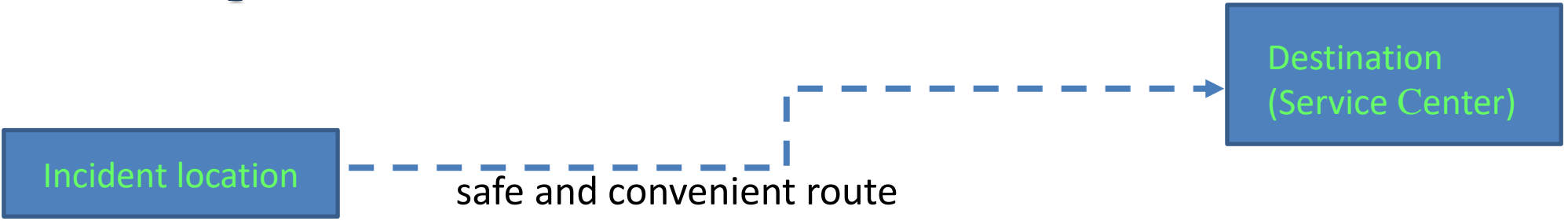


- i. One-ended Roads
- ii. Narrow Roads
- iii. Closed Road

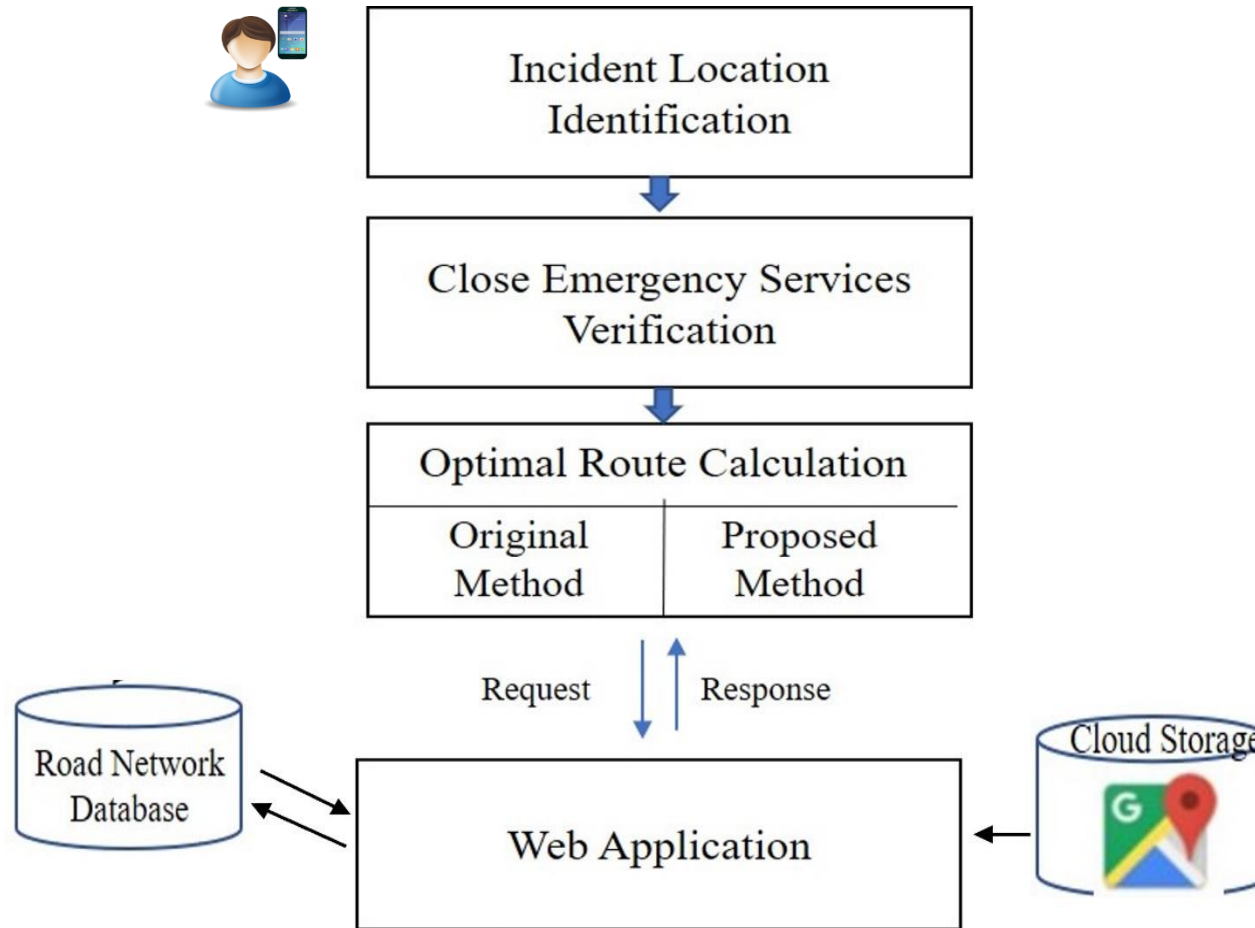
Optimal Evacuation Routes



What is the optimal route?

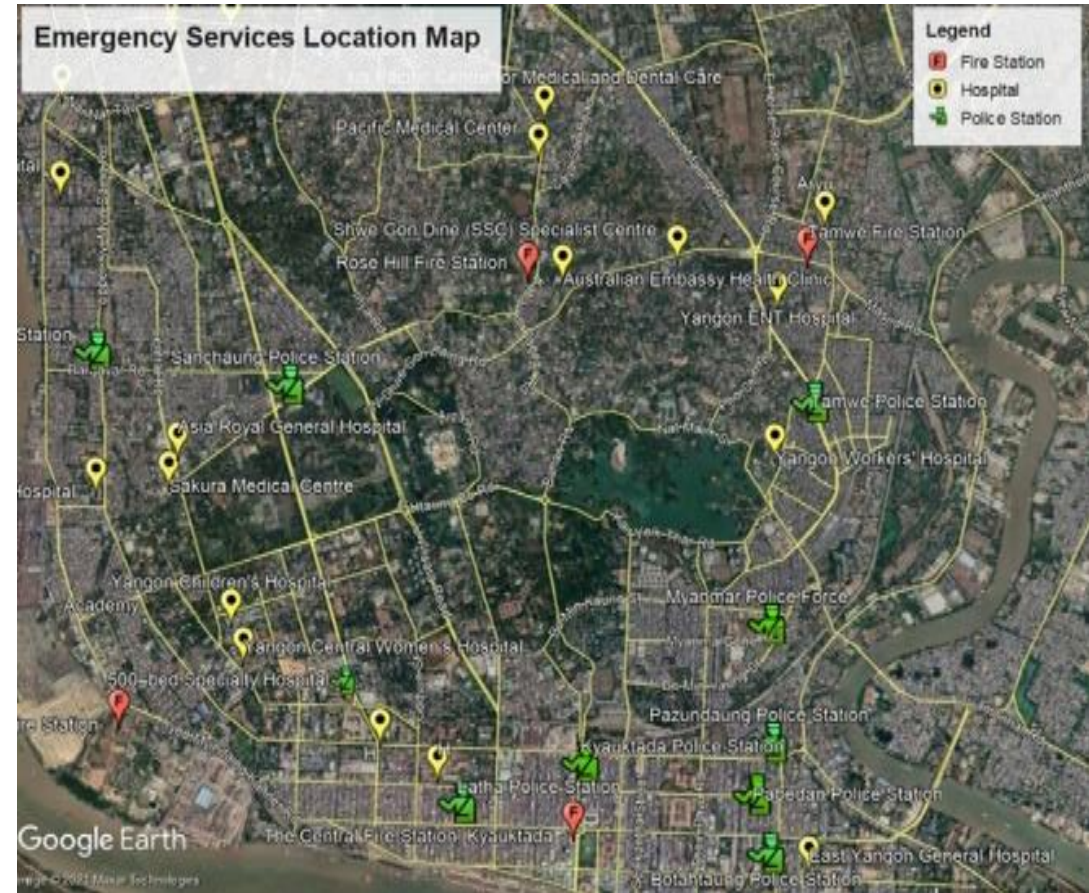


Overview of the Proposed System



Generating the Road Network Database

- Location data of road, latitude, longitude
 - 85 Hospitals and Clinics
 - 41 Fire force station
 - 50 Police Stations
 - narrow street
 - closed road
- Collecting the data Road network data for Yangon Region
 - Number nodes **54,485**
 - Number of edges **131,209**
- Data source: Myanmar Fire Brigade
ALARM organization
Google Map, GPS GARMIN etrex-10 device
- Creating the vector map of Yangon Road network, data analyzing and editing the special data information are performed by QGIS
(open-source packages as GRASS, PostGIS, Map and GIS server)



```
function ModifiedDijkstra(G, source,  
destination)
```

```
    dist[source] := 0 ;
```

```
    Q := the set of all nodes in  
    Graph ;
```

```
while Q is not empty:
```

```
    u := vertex in Q with smallest  
    distance in dist[ ] ;
```

```
    remove u from Q ;
```

```
    if d[u]==destination]
```

```
        break ;
```

```
    end if
```

```
for each neighbor v of u AND  
v.status!=1
```

```
    temp_d := d[u] + d_between(u,  
v) ;
```

```
    if temp_d < d[v]:
```

```
        d[v] := temp_d ;
```

```
        previous[v] := u ;
```

```
        decrease-key v in Q;
```

```
    end if
```

```
end for
```

```
end while
```

```
return d [destination];
```


Impact of the Proposed System

- This system will help the user and businesses to discover the safest and convenient way and direction between any two points (locations/services) on road networks (edges) of Google map.
- It can also deploy to search nearby refugee areas and carry the best rescue routes to evacuate people from dangerous areas.
- It will provide to develop the partial sequence route algorithm for trip planning mobile application of ancient began heritage region.
- This system also helps to reduce delay caused weak structure road network for emergency vehicles .
- Furthermore, the proposed approach of optimal route-finding system can be applied to various kinds of applications in social network.

The experiment of Optimal Route Estimating for Emergency Event

To Find Incident Place

Choose Street Address Here

Thu Kha Myaing

Identify Location

Find Close Emergency Services

```

82 <table>
83 <tr>
84 <td>
85 <td align="right">
86 <form id="createForm" action="IdentifyLocation.jsp" name="createForm" method="post" accept-charset="UTF-8">
87 <input type="text" value="Thu Kha Myaing" />
88 <input type="submit" value="Identify Location" />
89 </td>
90 </tr>
91 </table>
92
93 <div align="center">
94 <div align="center">
95 <div align="center">
96 <div align="center">
97 <div align="center">
98 <div align="center">
99 <div align="center">
100 <div align="center">
101 <div align="center">
102 <div align="center">

```

Geo Address is :Thu Kha Myaing
lat=16.84123555, long=96.1256616

(a) Incident Location Identification

Please Choose One Emergency Service to Find Optimal Route From Thu Kha Myaing

Hlaing
 Mayangon
 Bayn Nlaung

Find Optimal Route

```

1 package Routing;
2 import java.util.StringTokenizer;
3 import org.apache.commons.lang3.StringUtils;
4
5 public class TestService {
6
7     // 1000 auto-generated method stub
8     public static void main(String[] args) throws Exception {
9
10         double lat=16.85388648;
11         double long=96.1256616;
12         String[] latLong=StringUtils.split(StringUtils.join(lat+","+long),",");
13         System.out.println("Close Emergency Services From ("+"lat"+","+"long"+") ->");
14         for(int i=0;i<latLong.length;i++)
15         {
16             StringTokenizer st=new StringTokenizer(latLong[i],",");
17             String lat=st.nextToken();
18             String long=st.nextToken();
19             System.out.println("Close Service : "+(i+1)+" - ("+"lat"+","+long+")");
20         }
21     }
22 }

```

(b) Computing the Closed Emergency Services

Result of Optimal Route on Map\\

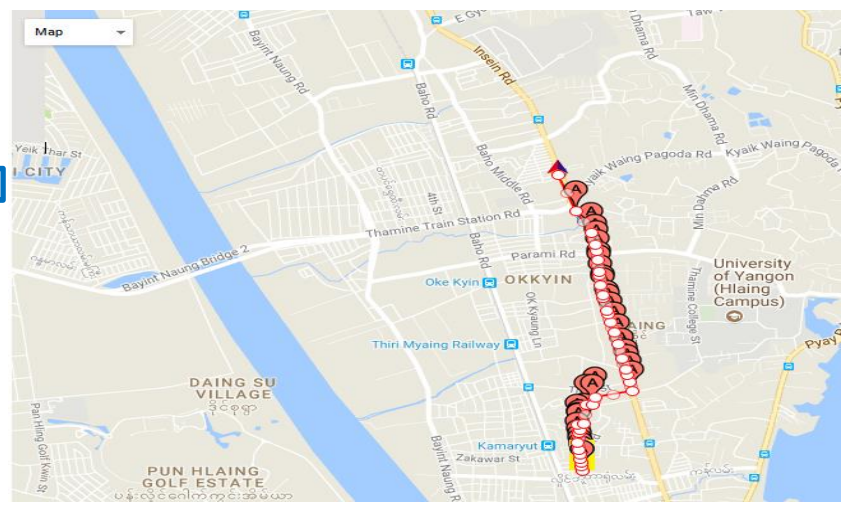
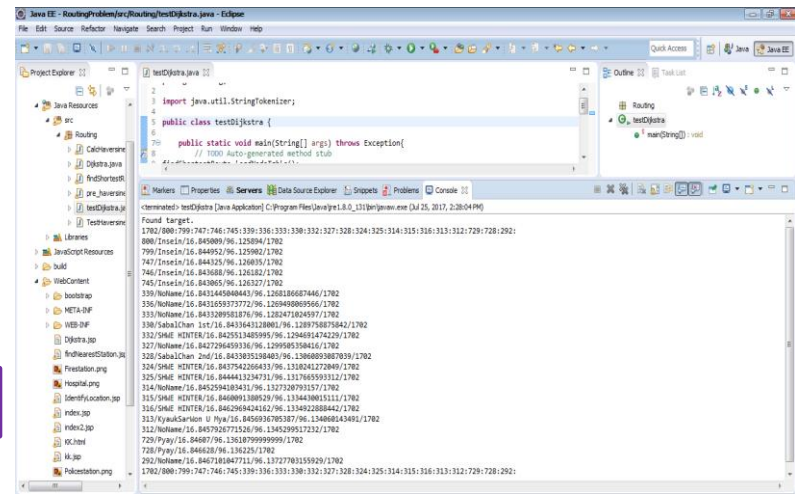
Total Distance → **1702/800:799:747:746:745:339:336:333:330:332:327:328:324:325:314:315:316:313:312:729:728:292**

800/Insein/16.845009/96.125894/1702 → **Start Node**

- 799/Insein/16.844952/96.125902/1702
- 747/Insein/16.844325/96.126035/1702
- 746/Insein/16.843688/96.126182/1702
- 745/Insein/16.843065/96.126327/1702
- 339/NoName/16.8431445040443/96.1268186687446/1702
- 336/NoName/16.8431659373772/96.1269498069566/1702
- 333/NoName/16.8433209581876/96.1282471024597/1702
- 330/SabalChan 1st/16.84333643128001/96.1289758875842/1702
- 332/SHWE HINTER/16.8425513485995/96.1294691474229/1702
- 327/NoName/16.8427296459336/96.1299505350416/1702
- 328/SabalChan 2nd/16.8433035198403/96.13060893087039/1702
- 324/SHWE HINTER/16.8437542266433/96.1310241272049/1702
- 325/SHWE HINTER/16.8444413234731/96.1317665593312/1702
- 314/NoName/16.8452594103431/96.1327320793157/1702
- 315/SHWE HINTER/16.8460091380529/96.1334430015111/1702
- 316/SHWE HINTER/16.8462969424162/96.1334922888442/1702
- 313/KyaukSarWon U
- Mya/16.8456936705387/96.134060143491/1702
- 312/NoName/16.8457926771526/96.1345299517232/1702
- 729/Pyay/16.84607/96.13610799999999/1702
- 728/Pyay/16.846628/96.136225/1702

Intermediate Nodes

292/NoName/16.8467101047711/96.13727703155929/1702 → **Target Node**



Conclusion

- To reduce the risk of emergency situations and save the people's lives, the Optimal Evacuation Routes of vehicle is predicted.
- The optimal evacuation route estimating algorithm is developed for complicated unstructured road network of Yangon based on the modified Dijkstra algorithm.
- The closed emergency service locations are examined for the incident place by using geospatial data and display the route result with detailed direction.
- The proposed work will help emergency rescue teams directly to reach the incident location in a short time save the lives and properties.
- The proposed algorithm will reduce the memory consumption and the processing time.
- On integrating with real time road traffic condition obtained by IOT sensor will be considered to improve this proposed approach.

Thank You

Contact : myintucsy@gmail.com;