Appendix 2.2

Report of International Conference Presentation

Name: (Presenter)	Myint Myint Sein
Affiliation:	University of Computer Studies, Yangon (UCSY), Myanmar
Project Title:	Context-Aware Disaster Mitigation using Mobile Edge Computing and Wireless Mesh Network
Name of International Conference: (Link to website)	2021 IEEE 10th Global Conference on Consumer Electronics (GCCE 2021); IEEE GCCE 2021, Kyoto, 12-15 October 2021 (ieee-gcce.org)
Title of Research Paper:	Effective Evacuation Route Strategy for Emergency Vehicles
Name of all Co-authors (if any)	K-zin Phyo(UCSY), Tham Mau Luen(UTAR), Yasunori Owada(NICT), Nordin Bin Ramli(MIMO), Suvit. Poomrittigul (PIT)

Comments or feedback received at the conference:

(e.g. Questions or comments received by your presentation)

Is this system possible to extend other complex and unstructured road network ?

Contribution to the project:

(e.g. Summary of your session or other sessions related with your presentation)

In this research, a unique optimization algorithm based on Dijkstra's algorithm has been upgraded, including the addition of certain parameters and conditional statement of roads to find the effective evacuation routes and better implementation of the safest and convenient routes.

Photos

[Required Documents]

A) Presentation Materials (e.g. PPT slides)

B) Final Program of the conference

Reporter: ___Myint Myint Sein_____

Date: ____15-10-2021_____

Effective Evacuation Route Strategy for Emergency Vehicles

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Y. Owada*** , N. Bin Ramli****** and S. Poomrittigul *******

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**** MIMOS, Malaysia
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GCCE 2021
Kyoto, JAPAN
October 12-15, 2021

OUTLINE

- Introduction
- Objective
- Generating the Road Network Database
- Proposed Optimal Route-Finding System
- Experiment and Results
- Conclusions and Future Works

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Introduction : Important Role of Optimal route

Emergency Cases

Accidents

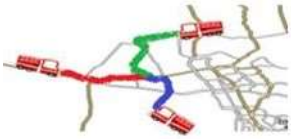
Crime, Fires, Explosion

Disaster

Show the Route to go Safe Place

Broadcast Call / SMS to Closest Service Stations

Need to arrive incident location within a short time



Calculate and Display Optimal Routes

Which route is optimal to get/give the effective response?

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Objective

- To develop an optimal route identification system for emergency event based on GIS by combining with web services.
- To examine the close emergency service and support the optimal route between the rescue services and the incident place by using geospatial data and display the route result with detailed direction.
- To modify and improve the original Dijkstra's Algorithm in order to apply the complex and large road network by reducing memory and time consumption.

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Generating the Road Network Database

Study Area - Yangon, Myanmar

latitude - 16.80528 and

longitude - 96.15611with 10,171 km^2.

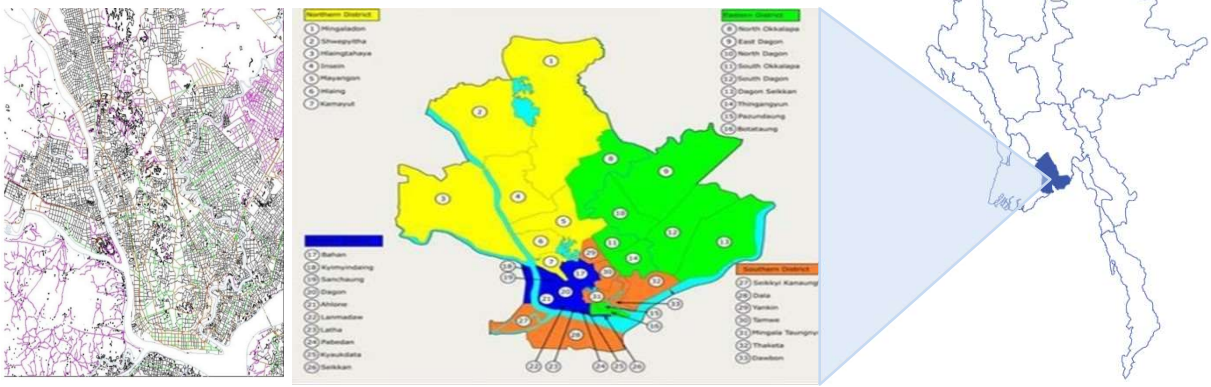

Fig A. Map of Yangon Division (45 -Townships)

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Data Creation Tools

- QGIS (Quantum Geographical Information System)
- QGIS incorporates with other open-source GIS packages
  (PostGIS, GRASS GIS, and Map-Server).
- QGIS supports vector data.

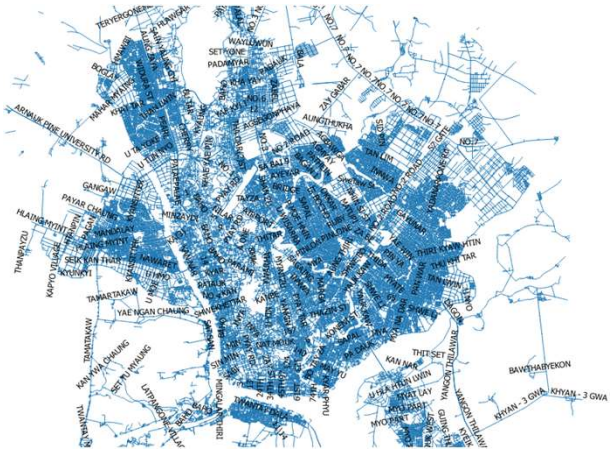

Fig . Road Network of Yangon Region

14-10- 2021, Section: OS-ICT

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Collecting the data for tested area

- location data of road, latitude, longitude

(Hospitals and Clinics, Fire force station, Police Stations)

41 Fire force Stations

No.	Name	Latitude	Longitude
1	Central Fire Station	16.779591	96.152645
2	Hmawbi Fire Station	17.106246	96.060307
3	Kyauktada Fire Station	16.776082	96.158498
:			
:			
:			
39	Ahone Fire Station	16.8366687	96.0762595
40	Kyeemyindaing Fire Station	16.812479	96.122159
41	Sanchaung Fire Station	16.804094	96.133036

85 Hospitals and Clinics

No.	Name	Latitude	Longitude
1	South Okkalapa Women and Children Hospital	16°50'40.63"N	96°11'12.26"E
2	Pacific Medical Center	16°49'2.05"N	96° 9'21.93"E
3	Insein General Hospital	16°53'31.01"N	96° 6'18.43"E
:			
:			
:			
84	Sakura Medical Centre	16°47'46.09"N	96° 7'50.14"
85	North Okkalapa General Hospital	16°54'2.17"N	96° 9'29.06"E

50 Police Stations

No.	Name	Latitude	Longitude
1	Bayint Naung Police Station	16°51'0.35"	96° 6'17.30"
2	Pazundaung Police Station	16°46'43.29	96°10'19.12
3	Pabedan Police Station	6°46'31.15	96°10'15.04
:	Kyauktada Police Station	16°46'38.59	96°10'29.38
:			
:			
48	Tamwe Police Station	16°48'1.96	96.0762595
49	Yankin Police Station	16°50'6.42	96° 9'38.51
50	Botahtaung Police Station	16°46'17.57	96°10'18.43

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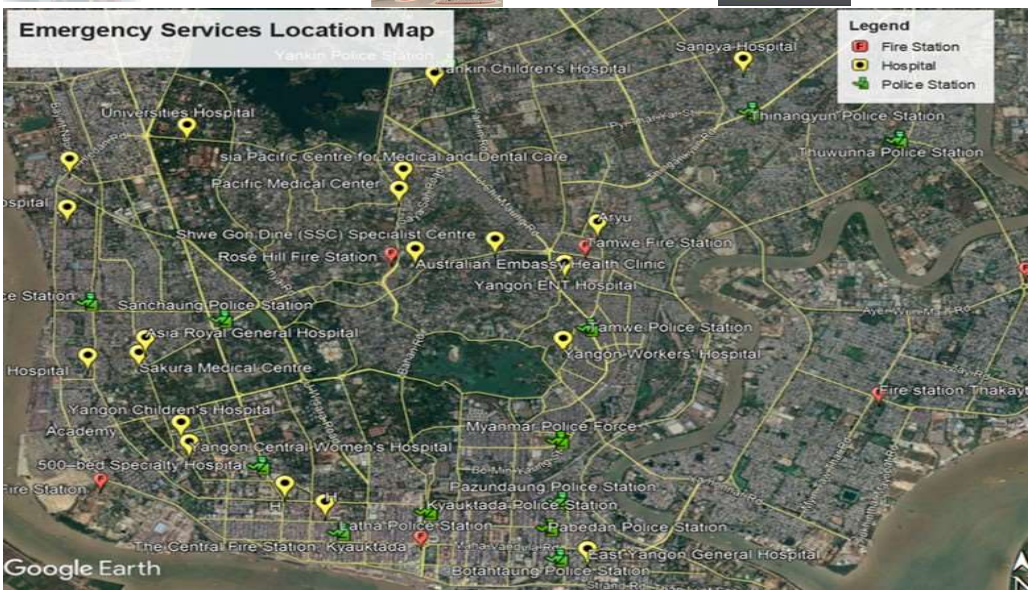
41 Fire force Stations

85 Hospitals and Clinics

50 Police Stations



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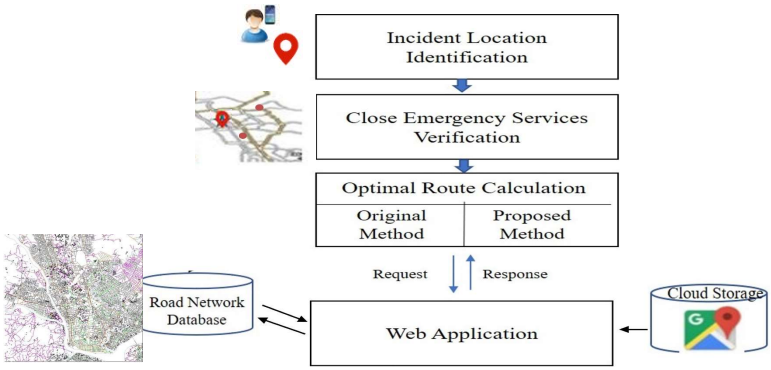
Proposed Optimal Route-Finding System

Overview of the Proposed System



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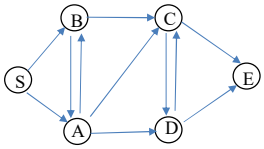
Computing the Optimal Route



Initialization
S= Source, E=Destination
Queue=>{S, A, B, C, D,E}
u = node in Graph with minimum d ;

v	S	A	B	C	D	E
d[v]	0	α	α	α	α	α

```
function Dijkstra(Graph, s)
    for each vertex v in Graph:
        d[v] := infinity ;
    end for ;
    d[s] := 0 ;
     while Graph is not empty:
         u := node in Graph with minimum d ;
        if d[u] = infinity:
             break ;
        end if ;
        remove u from Graph ;
        for each neighbor v of u in Graph:
            temp_d := d[u] + d(v, u) ;
             if temp_d < d[v]:
                 d[v] := temp_d ;
             end if ;
        end for ;
    end while ;
 return d[ ] ;
```

Table Runtime Complexity of Two Methods

Dijkstra's Algorithm	Original	Proposed
Data Structure	Array	Heap
Insert Operation (Add a node with its values to the priority queue)	O(1)	O(log n)
Extract-Min Operation (Extract the specified node with smaller value)	O(n)	O(1)
Decrease Key Operation (Replace the node which has the minimum value)	O(n)	O(log n)

```
function MDijkstra(V, s)
    d[s] ←0
    target ← t
    for all v ∈ V
        do d[v] ←infinity
    end for
    S←∅
    H_Queue←V

    while H_Queue ≠∅
        u ← ExtractMin (H_Queue,d)
        S←SU{u}
         if u==target
             break;
         end if
        for all v ∈ neighbors[u] and status(u,v) != 1
             if  d[v] > d[u] + w(u, v)
                 then     d[v] ←d[u] + w(u, v)

         end if
        end for
        end while
    return d[destination]
```

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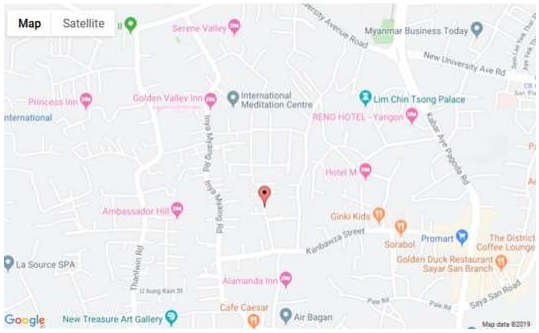
Experiment and Results

Computing the Optimal Evacuation Route for Fire vehicle

Incident Location
- KMS kyar street(Kanbawza lannthwe),
  Tamwe Town Ship,
  Yangon



(a) Incident Location Verification

(b) Estimated Nearest Emergency Location

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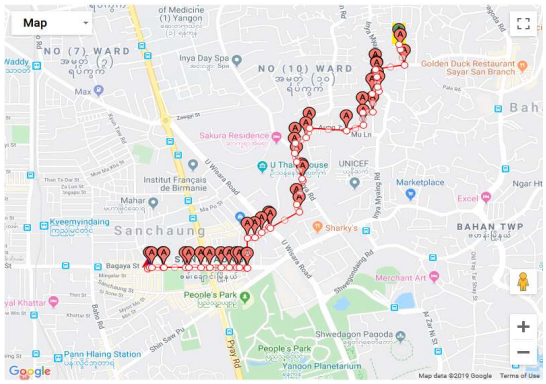
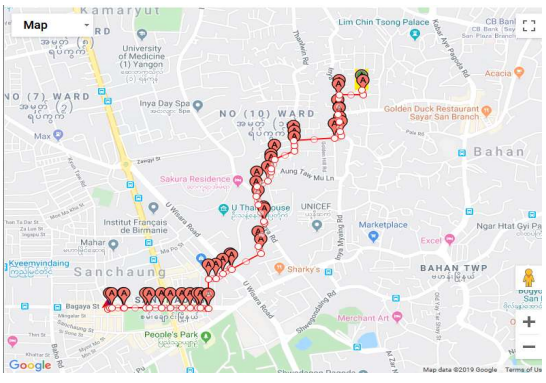
Experiment and Results

The Optimal Route between the Fire Dept. and incident location.
The optimal route computing results for original and proposed approach are illustrated in Fig (c) and (d), respectively.



(c) The result by original Dijkstra method



(d) The result by modified Dijkstra method

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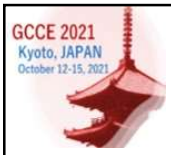
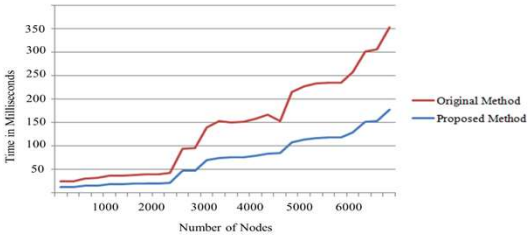


Table 1 Evaluation of Runtime Complexity

Run Time	10 nodes	100 nodes	1000 nodes	10000 nodes	100,000 nodes
O(1)	1	1	1	1	1
O(n)	10	100	1000	10000	100000
O(log n)	3	7	10	13	17



The computation time for number of nodes in each operation are shown in Table1. The comparison of the performance two methods with the number of visited nodes and processing time is shown in Figure.

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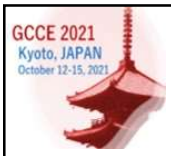

CONCLUSION AND FUTURE WORKS

- The estimating of effective emergency route strategy is proposed for complexed road network of Yangon.
- The proposed work will help emergency rescue teams to reach the incident location in a short time to save the lives and properties.
- On integrating with real time road traffic condition obtained by IOT sensor will be considered to improve this proposed approach.

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ACKNOWLEDGEMENTS

This publication is the output of the ASEAN IVO http://www.nict.go.jp/en/asean ivo /index.html project titled *Context-Aware Disaster Mitigation using Mobile Edge Computing and Wireless Mesh Network* and financially supported by NICT. (http://www.nict.go.jp/ en/index.html).

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Thank You

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