Shortest Route Selection for Adventuring Pyu Ancient City

Thin Thin Soe , Nay Chi Htun

***Abstract*—In recent years, tourism becomes popular in Pyay Township and the number of travellers who visit Pyay increases every year. Especially, most of the travellers want to tour Sri Ksetra Pyu Ancient City near Pyay for the existence of interesting ancient heritage. So, to improve the tourism around Pyay Township, the optimal route selection system is proposed for the travellers who visit the Pyu Ancient City. The proposed system utilizes Geographic Information System (GIS) for providing detail map information, and Dijkstra's algorithm for calculating the shortest routes. Pyu map and other information are stored in web server's database as geospatial database and mobile application that accesses these map data through web service technology is implemented in this system.**

Index Terms*— *GIS, Dijkstra's Algorithm, Shortest path, Location-based services (LBS), Web Service, mobile application

I. Introduction

Nowadays, most of the visitors want to tour around Pyay. In Pyay , Pyu Ancient City is popular for tourisms as the most interesting place which is located 8km (5.0 mi) to the south-east of modern Pyay. In case of travelling emergency, it is important to reach the location on a priority basis and a minor delay may cause major problems. Shortest path analysis helps in such critical situations by calculating the most optimal route. Optimal route finding is defined as the process of delineating the best route to get from one location to one or more locations. Pyu, an ancient city with natural beauty and historical places, is visited by many foreigners from different countries. For adventuring in Pyu Ancient City, the proposed shortest path finding system uses the Dijkstra's algorithm as a preferred shortest path algorithm as well as Geographical Information system (GIS). Location-based Services (LBS) are developing rapidly in the mobile and Information Technologies (IT) fields. Increase demand to modern technologies and interest in utilizing geospatial information servers to provide useful information and services to mobile users though wireless networks plays a very important factor to LBS advancement. This proposed system utilizes a location-based service for Pyu map information.

This paper is organized as follows: section 2 describes related work regarding the route or path finding analyses of GIS. Background theories of GIS, Location-based System and Dijkstra's algorithm are expressed in section 3. Section 4 represents about system design of optimal path finding algorithm with mobile device. Finally, section 5 draws the conclusion.

2) Related Works

Shortest route finding systems are widely used in various areas. Shortest Path system plays an important role in applications such as handling city emergency, driver guiding system, games, networking and travelling etc. The above problems can be solved through shortest path algorithms and GIS .In this system, mobile application accesses these map data through web service technology and then display on mobile to the visitor.

In 2010, M. Cai, Y.Deng and Z. Taung [1] implemented the GIS-based emergency response system that is widely used for the rescue of emergency such as earthquakes, forest fires, urban accidents and so on. Their approach also uses Dijkstra's algorithm to find the shortest path quickly.The main idea of this system needs to provide the shortest path for best emergency response force and for urban emergency rescue using high-precision geospatial data, such as lanes, traffic volume, length, conditions, and driving rules shows that is this approach is very feasible.

In 2011, Chen Zhen-Ting [4] works on the project of an improved K-th optimal path searching algorithm for mobile phone location using improved Dijkstra's optimal path algorithm and integrating K-th optimal path. The modified algorithm greatly improves the efficiency of searching; the search space and time cost effectively and also provides a new idea for solving the problem of matching network. It makes more finding time because of dividing region.

In 2012, Tao Peng and Xiaowen Wang [8] proposed the mobile based navigation web application system. The authors basically works on residential areas, schools, the rescue of emergency, traffic lights and the user-controlled factor of traffic and driving speeds for proving route plan, which finds the shortest path and shows the result as online map via web GIS application. Authors also used Dijkstra's algorithm to find the shortest path. The main aim of the project was to use and combine both the web GIS and mobile phones with GPS module for designing and developing a web base application which provides intelligent vehicle navigation system.

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In 2015,V . Bhanummurthy, V. M. Bothale and B. Kumar [2] find the shortest route for disaster situation between one facility and another. The entire road network has been visualized by using web application hosted on to the Geo Server, analyses are done using PostgreSQL and visualized by using web application.

3) Research Method Of The Proposed System

For adventuring in Pyu ancient city, the proposed system is implemented as the GIS-based system. The user can search from source to destination by using Dijkstra's shortest path algorithm. Android application for path finder is also implemented as mobile application of location-based services.

(A) *Geographical Information system (GIS)*

Shortest route finding can be performed using either the vector or the raster data model in GIS. These models have their respective strengths and weaknesses. In vector data structure, each objective is composed of a series of coordinated pairs, and it is very useful for finding paths in well-defined boundaries. In raster structure, they are very easy to handle and process and well suited for representing continuous spaces. GIS uses geography and computer-generated maps as an interface for integrating and accessing massive amounts of location-based information. Application of GIS is now being employed in a wide range of application. These are as follows:

- Urban and regional planning
- Environmental risk analysis
- Forest management
- Hazard analysis
- Emergency response
- Transportation planning
- Wildlife management
- Healthcare management [1]

Because of many advantages, this system uses GIS technology for accurate data measurement and GIS is a very important tool for many application areas, such as emergency, transportation and shortest path calculation for many cases. This system searches the nearest two destinations from one source. For this purpose, this system uses the raster data model of GIS. Among many nearest popular places, this system chooses two nearest destinations from one source. And then, this system calculates optimal paths using Dijkstra's algorithm.

(B) *Dijkstra's Algorithm*

The shortest path algorithms are widely used because it finds the quickest way to get from one location to another on a road map. Shortest path is the path that is the least length between two locations. There are a number of different algorithms for computing a shortest path. These are as follows:

- A* Algorithm,
- Bellman-Ford Algorithm,
- Johnson's Algorithm,
- Floyd-Roy-Warshall Algorithm and
- Dijkstra's Algorithm.

Dijkstra's algorithms used for calculating the shortest path, which introduced by the famous Dutch computer scientist Edsger W. Dijkstra, was recognized as the best algorithm that can be applied to get the shortest path from a node to any other nodes.[2]

Dijkstra's algorithm is called the single-source shortest path. It is also known as the single source shortest path problem. This algorithm computes the length of the shortest path from the source to each of the remaining vertices in the graph. It was clearly showed that the optimized algorithm is more applicable to calculate the shortest path. Shortest Path problems play an important role in applications of road network such as handling city emergency and driver guiding system. Basic concepts of network analysis with traffic problems are explored. There are usually large numbers of requests occurring due to changes in city traffic condition and, it needs to get solve quickly. The above problems can be solving through shortest paths by using the Dijkstra's Algorithm. Thus, it develops a new framework called towards online shortest path which enables drivers to quickly and effectively collect the traffic information.

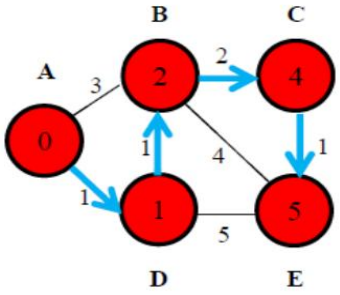

Figure 1: Shortest path by Dijkstra's Algorithm [3]

In this figure, node A is an initial node and to find the shortest paths from A to all other nodes. Dijkstra's will assign zero to initial node, node A while assigning infinity to all other nodes that are not visited. It will then assign a value gradually to get smallest value up to the destination, which is node E.

Step 1: Node A is set to become current node. Zero is assigned to node A and infinity to all other nodes.

Step 2: Consider all unvisited neighbors and tentative distance will be calculated. Previously recorded value will be replaced since new value less than infinity.

Step 3: Since all neighbors of node A have been taken into account, it is struck as visited and will not be tested again. The next least distance from node A, node D now will be marked as current node. Its neighboring nodes will be updated with the new minimal distance value.

Step 4: Since all neighbors of node D have been taken into account, it is marked as visited and will not be

checked over. The next minimal distance from node D, node B will now be marked as current node. Its neighboring nodes will be updated with the new minimal distance value.

Step 5: Since all neighbors of node B have been accounted for, it is marked as visited and will not be tested over. The next available minimal space from node B, which is node C now, will be taken as present node. Its neighboring nodes will be updated with afresh minimal distance value.

Step 6: Meanwhile, all neighbors of node C have been taken into account; it is marked as visited and will not be checked. The next shortest distance from node C is node E, which will be chosen as current node. Since all the nodes have been visited, the shortest route from node A to node E is found.

The shortest distance from Node A to Node E is:

A → D → B → C → E

(C) Location-based Services

In location-based services, some most recent location sensing technology based on ultra wideband radio can even achieve accuracies on the order of centimeters in an indoor environment. Meanwhile, the rapid evolution of cell phone industry from initial simple talk services to multiple functions of multimedia messaging and voice services with the emergence of broadband wireless infrastructure has created tremendous demands for various location-based services(LBS). Both online map services (e.g. Map quest) and the Internet GIS can be considered important LBS applications as they provide the kind of geographic information services via the internet or mobile-networked environments to mobile devices.

LBS are indeed partially evolved from the online map services and other Internet GIS applications whereas current LBS mainly rely on lightweight mobile devices such as personal digital assistants (PDA) and smart phones. A true LBS application aims to provide personalized services to mobile users whose locations are in change as shown in Fig 2.

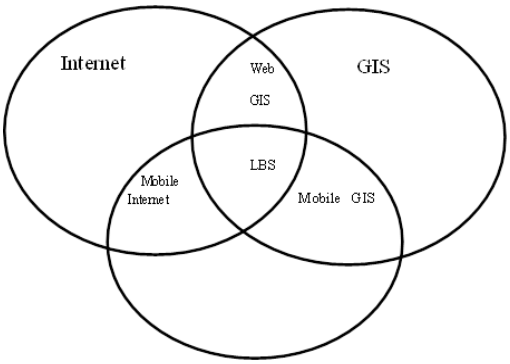

Figure 2: Location-based Service Source

4) SHORTEST PATH FINDING SYSTEM WITH MOBILE DEVICE

The proposed system can also search the optimal route through mobile device on which shortest path that is calculated on server. In this shortest path finding system, the visitors can find one source node and one destination node on mobile. And then finding the path to require destination is also added as a location-based service for visitors. User's current location is detected by Global Positioning System (GPS) and mobile phones access data from web server through wireless local area networks (WLAN). Dijkstra's algorithm is used for finding the shortest path. Mobile application is implemented through Pyu map.

Visual C#, ASP.NET programming language is used to implement the web-based system and android application development is used for mobile application for location-based services. The home page of the system on server is shown in Fig 3.

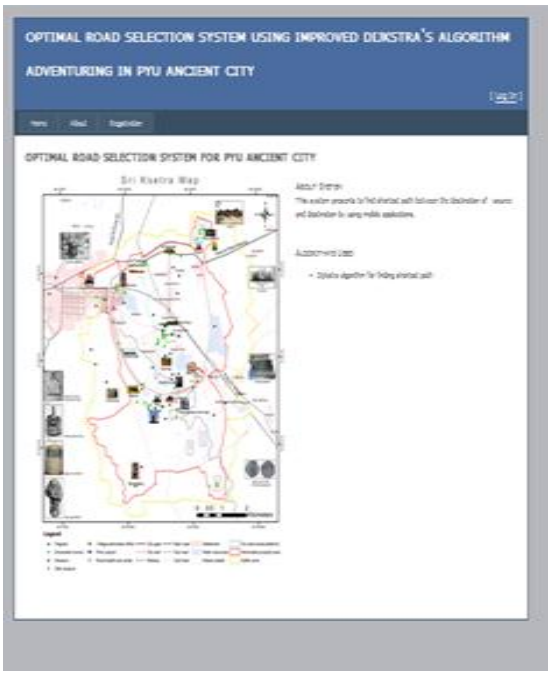

Figure 3: Home page of the System

The proposed system focuses on twenty famous places around Pyu Ancient city. The visitor can choose one source place and one destination place from these famous places. After the visitor has selected the source and destination place, the proposed system finds the shortest routes between two places by using Dijkstra's Algorithm on server. Here GIS technology is also used for measuring accurate distance on Pyu Ancient city map.

For the location based direction service, Dijkstra's shortest path algorithm is applied to find the path to destination. Then the shortest route to the destination is displayed to visitor on mobile device. Proposed system design is shown in Fig 4 and Fig 5.

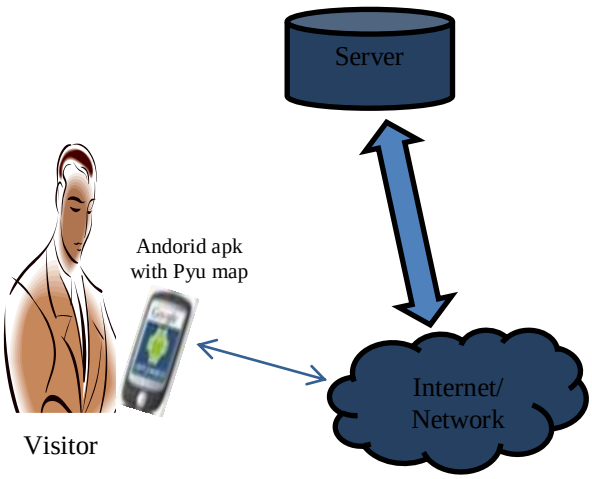

Figure 4: System Implementation Design

To use the system, it is needed to register on server .After registering on the server; visitors can login to the system using their user name and password as described in the following figures.

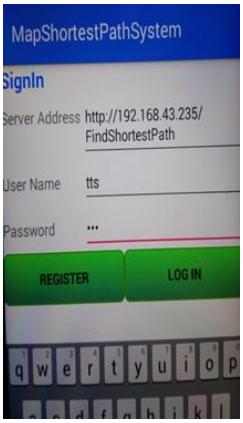

Fig 5(a)

Fig 5(b)

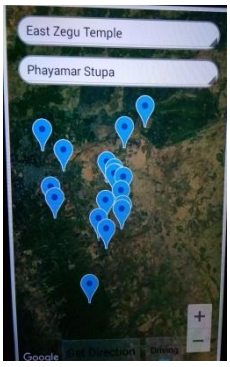

Fig 5(c)

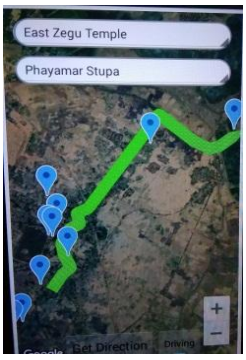

Fig 5(d)

Figure 5(a)(b)(c)(d): The Shortest Route Selection between one source pagoda and one destination pagoda on mobile step by step

As shown in figure 5, East Zegu Pagoda (EZP) is selected as the source pagoda and destination pagoda is Payamar (PHM).There are eleven paths between source and destination.

In the final result path, there are two pagodas Rahanda (Rhd), Shwezayan between the source and destination pagodas and this path has the distance, 5km.

For this case, Dijkstra's algorithm chooses this path as the shortest route between the two places and shows the final result path on mobile .Because it has the minimum distance with 5km than other paths.

6) Conclusion

The proposed system implements shortest route finding system for travelling in Pyu ancient city through mobile application. Visitor's current location is computed based on the current coordinates via GIS and the shortest routes are calculated by using Dijkstra's Algorithm. The main advantage of the system is mobility: a visitor who carrying a mobile phone can go the famous places in Pyu ancient city with the best routes by using the proposed application. So, the proposed system helps the travellers who visit the Pyu ancient city to enjoy the taste of precious heritage without a tour guide.

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