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The Study of Tourist Behavior and the Development of Local Community Travel Routes from Talaybuadang to Khamchanod in Udonthani

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Abstract

The research article entitled "The Study of Tourist Behavior and the Development of Local Community Travel Routes from Talaybuadang to Khamchanod in Udonthani" was intended to develop new travel routes in Udonthani so as to improve tourism in Udonthani and neighboring provinces and to develop a new travel platform using websites and applications as a medium connecting communities with tourists with ease. The present study employed social network analysis. Tourist attractions and activities in Udonthani were determined as nodes in the network. In addition, it investigated travel behavior among 400 tourists to serve as edges between each node so as to establish a travel network connecting tourist spots in the province in which Khamchanod and Talaybuadang were primary tourist attractions. Social network analysis was then conducted; as a result, there were 5 main tourist attractions, 17 secondary tourist attractions and 8 community and local business tourist spots. Despite that, the results indicated that the eigenvector centrality score was most consistent with the sample group's satisfaction level. Subsequently, the research team developed travel routes each with primary tourist attractions, accompanied by secondary tourist attractions and community and local business tourist spots. More importantly, all travel routes must have close eigenvector centrality values. Consequently, there were 16 suitable travel routes. Once 16 travel routes were established, the satisfaction among 400 tourists was investigated. It was discovered that the tourists' satisfaction towards all 16 travel routes was at the highest level with a mean score of 4.55 and a standard deviation of 0.53. Afterwards, the researchers presented all 16 travel routes via the Android application named "Tiew Muang Rong Udonthani" (Secondary City Tourism in Udonthani) on Google Play Store. The satisfaction of 400 tourists was at a high level with a mean score of 4.48 and a standard deviation of 0.63.

Keyword: *Social Network Analysis, Travel Routes, Udonthani*

1. Introduction

Udonthani is a province with identities and distinction as the origin of Esan heritage and the lifestyles of people in Mekong river, and its distinctive features extend to eating, music, natural attractions and dhamma sites which are worth for the entrance of new Esan. In fact, the word E S A N conveys several meanings; specifically, *Eating* refers to eating identities such as sticky rice and papaya salad, *Song* involves music and performing arts identities such as Morlam and Ponglang, *Amazing destination* is relative to fascinating tourist attractions as in Talaybuadang, Watpaphukon and Phutok, and *Natural life* pertains to living identities of people assimilating with nature, generosity and friendliness to visitors. In terms of economy, the upper northeastern provinces have geographic potential which can connect transportation in ASEAN countries, are undertaking the construction project of the Nong Khai-Khon Kaen double-track railway and, most importantly, are one of China's strategic plans One Belt One Road. Thus, it can be stated that they are transitioning into new Esan with considerable economic growth and developing into the land of opportunities for entrepreneurs, investors and people in the areas (National News Bureau of Thailand, 2018).

There are only a few tourist attractions in Udonthani, irrespective of the fact that its location is suitable and can accommodate tourists. In fact, its well-known tourist attractions are Talaybuadang and

Khamchanod. If both places are used as a basis to explore new tourist spots and design interesting travel routes, it will contribute to an influx of tourists and promote travel activities throughout the year. As an example, there is a salt farm in Bandung district, apart from Khamchanod, with spectacular scenery which should be perceived as Esan sea and cultural foods. Serving as a new tourist attraction, it will in turn create occupational opportunities and generate sustainable incomes for salt and rice farmers and people in communities.

Currently, with the technological advancement, social media or online channels are becoming increasingly important for information retrieval and increase convenience of travel among tourists. Based on Euromonitor's prediction, the global average growth rate of online travel revenues would be 10% per year, which increased from 166 thousand million dollars in 2011 to 363 thousand million dollars in 2020. Notwithstanding that, Thailand's infrastructure and potential of information and communication system have had some limitations to development. As a result, the Second National Tourism Development Plan (2017-2021) provides that the government shall give precedence to investments in developing and promoting an online tourism system as well as promoting new information technology for local businesses in response to changing tourism trends. However, Thailand's tourism has still fallen behind with promotion of information and convenience for tourists via online channels which are urged to be developed to fulfill their future needs (National Tourism Policy Committee, 2016).

Therefore, the present research aimed to develop an online-offline travel application for travel routes from Talaybuadang to Khamchanod in Udonthani. It was conducted in the hope of developing new travel routes to improve tourism in Udonthani and nearby provinces and to develop a new travel platform using websites and applications as a medium to connect communities with tourists with ease. Moreover, social network analysis was employed to facilitate the development of new travel routes according to tourists' needs.

Social network analysis is defined as an analysis of mathematical structure in terms of graphs consisting of nodes and edges that connect one another to create networks (Freeman, 2004; Knoke, & Yang, 2008; Otte, & Rousseau, 2002; Prell, 2012). In the analysis, a node qualified as the best representative of nodes is selected. There are many qualities in the analysis. However, in this study, degree centrality, triangles, betweenness centrality, closeness centrality, clustering coefficient and eigenvector centrality were used to find the best representative of nodes representing the prime ministerial candidate of Thailand reflecting the most satisfaction of the voters for both majority and minority.

Borgatti, Mehra, Brass, and Labianca (2009) proposed that the importance of social network analysis is to calculate centrality values of the social network graphs. On the other hand, this study considers values that are appropriate for the network of votes in Thailand's election as described below.

Degree centrality is the fundamental degree centrality having been used since the early study of graph theory. It counts how many lines or edges the nodes have and consists of both degree centrality and weight degree centrality (Golbeck, 2013; Golbeck, 2015). The degree centrality is the simplest centrality to compute but has little political reconciliation.

There is a hypothesis of betweenness centrality that any nodes present between the connection of other nodes serve as the hub of the network because the node in this position is able to control any interactions among the nodes connected through the node itself (Goh, Oh, Kahng, & Kim, 2003). The node can serve as the controller of the door of relations or prevent any undesirable connection (Wasserman, & Faust, 1994). The algebraic equation of the betweenness centrality or $b(i)$ of i is shown below.

$$b(i) = \sum_{j.k} \frac{g_{jik}}{g_{jk}}$$

g_{jik} is a number of the shortest edge from the hub j to k through i.

g_{jk} is a number of the shortest edge from hub j to hub k.

Closeness centrality is a measure of the speed of a node and to what extent it is able to connect to the other nodes in the network (Ruhnau, 2000). The edges that directly come out and indirectly come out through other nodes in the network are considered. This means the higher score of closeness a node has, the faster ability it has to connect to or affect other nodes. Moreover, the closeness with a high score indicates

the efficiency of communication about information or comments throughout the network, and this also expresses little necessity of dependence on other nodes in transferring the information. Therefore, the algebraic equation of closeness centrality or $b(i)$ of node i can be written as follows:

$$c(i) = \sum_j d_{ij}$$

d_{ij} is a number of connections in the shortest distance from i to j.

Clustering coefficient is a measure of cluster (Schank, & Wagner, 2005). That is, if a group of nodes represents a cluster, it means that the group has high density of nodes at that network area. However, if clustering coefficient equals to 1, it means that every node directly connects to the other nodes in the network, but if the clustering coefficient equals to 0, it means there is not any connection among the nodes in the network.

$$cc(v) = \frac{2N_v}{K_v(K_v - 1)}$$

K_v is a number of nodes connecting to the centrality.

N_v is a number of relations of edges between the node and the centrality.

Eigenvector centrality is a measure of the influence value of the network elements. The principle used is that an element connecting to other elements with high influence values has higher eigenvalue than that connecting to other elements with low influence values (Ruhnau, 2000).

Chairatana, and Na Thalang (2017) formulated an integrated tourism development plan in Udonthani and investigated satisfaction towards the assessment of the potential of sustainable tourism development in Udonthani. Her study found that: in terms of nature, Khamchanod in Bandung district was rated with the highest mean score, with Nongprachak public park coming in second, while Phufoilom in Nongsaeng district had the lowest mean score. As regards cultures and history, Watpaphukon in Namsom district achieved the highest mean score, secondarily followed by Khamchanod in Bandung district. Watnakhathewi in Bannakha, Mueang Udonthani district was rated with the lowest mean score. On festivals, it was discovered that the worship of Prince Prajak annually held on January 18th at the statue of Prince Prajak was rated with the highest mean score, while the worship of Phraphutthabatbuabok at Watphraphutthabatbuabok in Banphue district came second. Mango's fair in Nong wua so district had the lowest mean score. Concerning activities, paying respect to buddha and making a wish at Watpabantad in Mueang Udonthani district earned the highest score, with a sightseeing cruise in Talaybuadang in Kumphawapi district coming in second place. Loy krathong festival held at Nongprachak public park was rated with the lowest mean score. Regarding services, the aspect with the highest mean score was the convenience of transportation modes, e.g. vehicles, buses, trains and air planes, and the sufficient accommodation for tourists, e.g. hotels, resorts and homestays, and its reasonable prices came second. The aspect with the lowest mean score was clarity of the sign, such as directional signs and advertising.

In conclusion, the qualitative research conducted through a review of literature, observation, interviews and meetings with three groups of concerned parties, e.g. the public sector, the private sector and people in tourist attractions, found that maintaining tourist satisfaction for repeat purchases and word of mouth would promote the popularity of tourist attractions and allow for continuous marketing.

Aeknarajindawat (2018) reveals that the development approach for the Talaybuadang, Udonthani province creative tourism included six areas: (1) diverse tourist attraction development, (2) increase in channels and access to tourist information, for examples, tourism websites, or biking activity, (3) increase in the facilities, (4) organizing various tourism activities, (5) tourism services, (6) tourism development with the integration of public, private, tourist and community partnerships, as well as the establishment of tourism network among six ferries and the nearby tourist attractions.

Sritalalai (2020) conducted a study on cultural tourism in the belief about "Naga" of Thai tourists in the northeast Thailand (Udonthani, Nongkhai, Bueng Kan, and Nakhon Phanom province). It was found that as regards purposes of travel, the majority of the sample intended to relax themselves and enhance their knowledge and experience on tourist attractions or Naga-based traditions in which they share belief. Apart

from that, the results showed that the most preferred tourist attraction was Khamchanod forest, Udonthani province.

In the meantime, Sujjasapho (2020) carried out research on promoting approach for Buddhist tourism management of temples in Nayung district, Udonthani province. The results showed that regarding problem states of Buddhist tourism management, Watpaphukon had six aspects as follows: 1) accommodation: inadequate accommodations for dhamma practice; 2) personnel: a lack of interpreters; 3) temple development: a landscape in Buddhism-based tourism; 4) environmental conservation: appreciation of the environment; 5) tourism: insufficient public relations; and 6) facilities: convenient transport and sufficient parking lots. Moreover, Watpanakhamnoi had two aspects, namely waste management including waste disposal and unsorted waste, and public relations as in a need for public relations of spiritual tourism.

Angskun, and Angskun (2014) also conducted a study on the design and development of an online travel itinerary planner under energy saving constraints. The study points out that tourists are using the Internet as an important tool to design travel plans; specifically, they use it not only to search for desired destinations but also to minimize travel expenses effectively.

Jungsaman, Lonkuntod, Wongchaipatoom, and Doomnin (2020) developed an Android-based mobile application for tourist attractions in Surin; the application can show information of the destinations, pinpoint users' location, display news from websites and search for information of tourist attractions. The results demonstrated that there was a high level of overall satisfaction among the users towards the mobile application.

Similar to the previous study, Chormuan, Jaidee, and Kasetpaisit (2014) developed an Android-based travel application. It was purposefully designed to provide convenience of travel for tourists desiring to travel to Kanchanaburi by allowing them to search for relevant information and watch videos of tourist attractions before making decisions; the application can also arrange tourist attractions based on graph theory and simulate the shortest route to minimize expenses and duration, and it can identify tourists' location during travel to ensure the correct route to the destination as well. On tourists' satisfaction towards the application, the results demonstrated that they were satisfied with the application ($\bar{X}$ = 4.37, S.D. = 0.47).

Similarly, Sittiwiset, Tungkawet, Nanthapoom, Yomchinda, and Thepbundit (2019) developed an application for promoting self-guided tourism in Nang Lae sub-district, Chiang Rai, and investigated Thai and foreign tourists' satisfaction towards the application. In terms of the application development, nine tourist attractions and seven restaurants and cafes were chosen by the community. In addition, regarding qualified experts' quality evaluation, the application was rated with the highest level of overall quality ($\bar{X}$ = 4.45, S.D. = 0.61). It was also found that there was a high level of tourists' overall satisfaction towards the application ($\bar{X}$ = 4.12, S.D. = 1.45).

As evidenced in prior studies, it can be noticed that the major problem of tourism in Udonthani lies in inadequate public relations and facilities. What's more, the literature on travel application development points out that the application indeed is effective and can satisfy tourists remarkably. Consequently, the present study sought to develop the application to promote tourism in Udonthani.

2. Objectives

The objectives of this study are listed as follows:

1) To develop new travel routes in Udonthani so as to improve tourism in Udonthani and neighboring provinces

2) To develop a new travel platform with websites and applications as a medium connecting communities and tourists with ease.

3. Materials and Methods

The research consisted of 5 steps executed for the period of 6 months. All steps are detailed below.

3.1 Data Collection

Data were collected and synthesized from a thorough review of books, documents and prior studies related to tourism management and a community way of life in Udonthani. Afterwards, the research proceeded as clarified below.

1) The research team and villagers formulated a plan and undertook a field study to obtain data on existing and new community lifestyle tourist attractions, natural attractions and architecture which could be used to map travel routes in the application.

2) The research team approached community leaders, a government sector, public and private organizations and politicians for establishing a collaboration and liaison network which would contribute to achieving the objectives of this research.

3.2 Application Creation and Development

After the collection of data on community lifestyle attractions and other tourist attractions in the areas, the application was created while travel routes were designed as elucidated below.

1) The researchers reached a conclusion and designed the application in concert with villagers, travel bloggers and communities in the areas to fulfill communities' and tourists' needs successfully and to benefit community lifestyle-based tourism in Udonthani. It was also designed for ease of use for villager users as well as ease of searching travel routes according to tourists' needs.

2) Public relations activities for the project were undertaken to encourage communities ready to be community local tourist attractions to be included in travel routes.

3) A training session, a seminar and a share and learn meeting, together with a field study, were organized; guest speakers and community representatives of community lifestyle tourist attraction models offered suggestions to communities ready to be developed into community lifestyle tourist attractions. After the training session and the seminar, the communities' readiness was assessed before being developed into community lifestyle tourist attractions.

4) 16 travel routes were designed using social network analysis. In particular, the routes would connect to Talaybuadang, Khamchanod and Esan sea which can be traveled within one day. Apart from that, tourists in Udonthani's opinions were explored while travel routes were also improved to fulfill tourists' needs.

5) The application was then developed on the basis of ease of use, a beautiful user interface and novelty. It comes with a One Day Trip menu which displays all 16 travel routes, It allows tourists to choose travel routes based on suggestions and provides information on experiences of community lifestyles in each route to help tourists choose the routes and to improve the their quality .

6) Upon the completion of application creation, community representatives as community lifestyle tourist attractions in the project were trained in the use of the application by the research team. Particularly, the simulation was performed to test the system and their understanding. Moreover, their opinions, satisfaction and suggestions were sought and taken into account to help improve the application.

7) The survey results from 6 were taken into account to enhance the efficiency of the application according to communities' and tourists' use. The opinion survey and the application improvement were constantly conducted throughout the period of this research and after the official launch.

8) The trial version of the application was released.

The research team formulated the following conceptual framework to develop the efficient and practical application as shown in Figure 1.

3.3 Quality Testing for Website and Travel Route Development

Application tests serve as the essential process. Given that this form of the service was still a novel idea for the communities participating in this project, they may have encountered certain problems and were unable to solve them. The research proceeded as clarified below.

1) In the trial, the sample group used the application to allow community lifestyle attractions to provide full services in practice. It would help identify issues before the official launch.

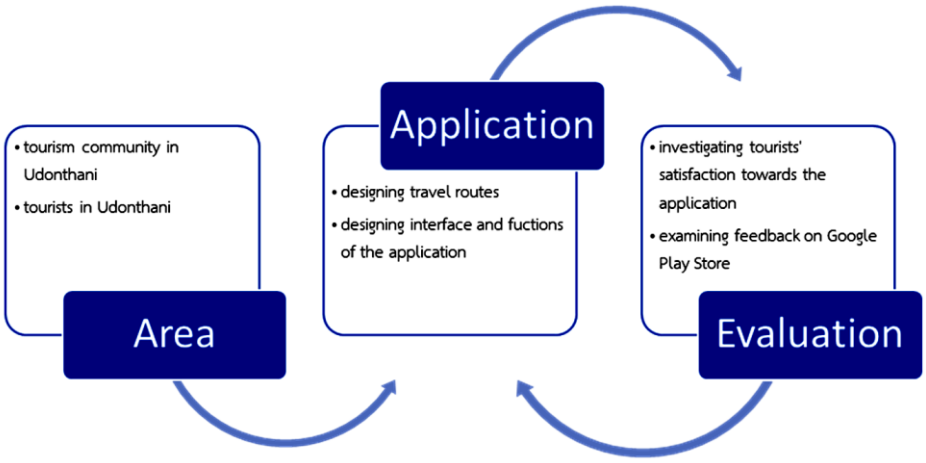

Figure 1 Conceptual framework for research

2) After the trial, a meeting of the community representatives was held. The sample group as the first group of users also joined this meeting to share their experiences, suggestions and issues as well as to seek solutions in concert with the community representatives. This was regarded as the crucial step to allow the community representatives and local guides to exchange their thoughts with the sample group. It would also promote villagers' confidence in the service provision of the project.

3) The research team had a meeting to review the implementation to analyze outcomes and to improve the application efficiency before further public relations.

3.4 Official Launch and Value Creation of Research Results

This process involved the official launch and public relations of the application for tourists' application trial.

1) The application was officially launched.

2) Documents for public relations through various channels were produced, for example, sending articles to bloggers and other media in Thailand for news publication, creating and sharing infographics in social media, purchasing ads on those media and hiring well-known bloggers to use the application and publish contents which create effective impacts on search results in Google or other websites. Based on Thiangthae, Napompech, and Kuawiriyapan (2016), study the Internet most influences decisions to travel to Thailand. Thus, the researchers were able to manage public relations in accordance with the goals most effectively.

3.5 Conclusion of Research Results

The research team concluded research results and sought feedback from villagers in the involved communities, the tourist users and social media users to improve the application, travel routes and services to achieve the objectives of the project.

4. Results

After the research team and community leaders collected the data and developed the application, the training program, the seminar, the share and learn meeting (as shown in Figure 2) and the field study were conducted to provide suggestions for communities and local businesses interested to participate in the project. Subsequently, 8 communities and local businesses were chosen to be developed into tourist attractions, namely Dose factory, Gray cabin, Option coffee bar, The good day café, Banna café, Phaeangnamphan, Suansittikorn and Khiriwongkot village.

Figure 2 Share and learn meeting

The research team and the communities also discussed popular tourist attractions in Udonthani. As a result, another 22 tourist attractions were chosen, including Khamchanod, Huailuang dam, Talaybuadang, Khoinang waterfall, Hintang waterfall, Udonthani city museum, Banchiang national museum, Phufoilom, Wangsammor forest park, Watthamsumonthaphaowana, Watpabantad, Watpaphukon, Watpadongrai, Watpothisomphon, Watphuthongthepnimit, UD town (lifestyle mall), Nongprachak public park, Ho Chi Minh educational and tourism historical site, Huaitatkha reservoir, Nayung-Namsom national park, Than-ngam waterfall and Phuphrabat historical park.

4.1 Social Network Analysis

After determining 30 tourist attractions through a share and learn meeting with the communities, the research team undertook a field study in tourist attractions to distribute questionnaires and conduct interviews with 400 tourists about travel in Udonthani and about which of the 30 attractions they visited each time. A cross-national sample of 400 participants was determined by Yamane's calculation formula, particularly, the population was all tourists traveling to Udonthani in 2020, as shown in Table 1.

Table 1 A total number of tourists visiting Udonthani in 2020.

Population of the research	Number
Thai tourists	2,200,819
Foreign tourists	35,473
In total	**2,236,292**

Source: Minister of Tourism and Sports (2021)

Afterwards, all 400 responses were drawn on to generate a table provided that a tourist has traveled to both attractions A and B in each of their trips, the value in AB and BA is 1. As a result, a relationship table of all 30 tourist attractions was produced and further drawn on to generate a network with weight as shown in Figure 3.

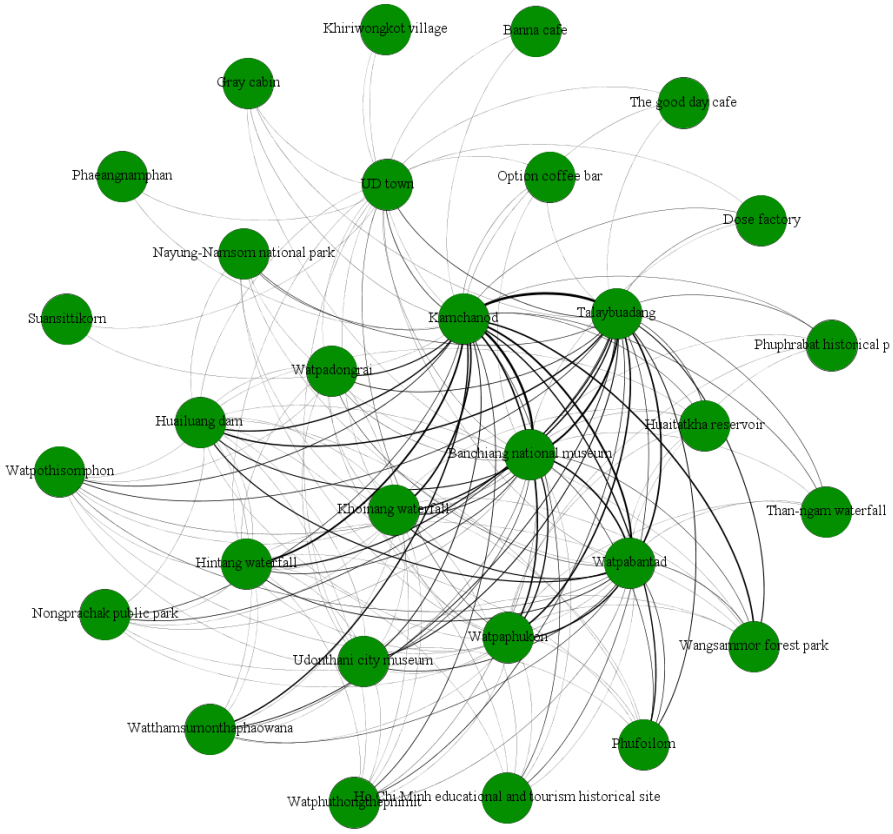

Figure 3 The network of the relationship among tourist attractions

Afterwards, the network of the relationship among tourist attractions was analyzed to calculate degree centrality, betweenness centrality, closeness centrality, clustering coefficient and eigenvector centrality using the NodeXL software. The analysis showed that the first five tourist attractions with the highest centrality were Khamchanod, Talaybuadang, Banchiang national museum, Watpabantad and Watpaphukon.

Table 2 The first five tourist attractions with the highest centrality.

ID	Degree	Betweeness	Closness	Clustering	Eigenvector
Khamchanod	29	112.7440476	1	0.167487681	1
Talaybuadang	25	39.74404762	0.878787879	0.219999999	0.969925917
Banchiang national museum	24	30.57738095	0.852941176	0.23550725	0.958435578
Watpabantad	21	13.57738095	0.783783784	0.288095236	0.912231624
Watpaphukon	21	13.57738095	0.783783784	0.288095236	0.912231624

As shown in Table 2, degree centrality refers to a number of routes or lines connecting a particular tourist attraction, and betweenness centrality is defined as the extent to which such an attraction is a passage through the destination or other places. Closeness centrality involves the closeness of a particular tourist attraction to the others while clustering coefficient indicates how frequently such a tourist spot is included in tourists' travel itinerary. Lastly, eigenvector centrality points out the extent to which such an attraction can influence tourists to visit the other places.

The research team further explored satisfaction towards the results; the centrality was calculated using social network analysis with the sample of 400 tourists. It was showed that eigenvector centrality ranked the centrality which was most consistent with the sample group's satisfaction; it had a score of 4.5 and a standard deviation of 0.58. Eigenvector centrality of all 30 tourist attractions is displayed in Table 3.

Table 3 The eigenvector centrality of 30 tourist attractions.

ID	Eigenvector
Khamchanod	1
Talaybuadang	0.969925917
Banchiang national museum	0.958435578
Watpabantad	0.912231624
Watpaphukon	0.912231624
Huailuang dam	0.872385648
Khoinang waterfall	0.872385648
Hintang waterfall	0.818474937
Udonthani city museum	0.75797099
UD town(lifestyle mall)	0.673870911
Watpadongrai	0.65804766
Watpothisomphon	0.579477869
Watphuthongthepnimit	0.579477869
Phufoilom	0.53593838
Wangsammor forest park	0.53593838
Watthamsumonthaphaowana	0.53593838
Nongprachak public park	0.485832972
Ho Chi Minh educational and tourism historical site	0.485832972
Huaitatkha reservoir	0.431725527
Nayung-Namsom national park	0.431725527
Than-ngam waterfall	0.31631346
Phuphrabat historical park	0.31631346
Dose factory	0.240879397
Gray cabin	0.240879397
Option coffee bar	0.240879397
The good day café	0.177133278
Banna café	0.112526981
Phaeangnamphan	0.112526981
Suansittikorn	0.112526981
Khiriwongkot village	0.112526981

The eigenvector centrality of tourist attractions could be ranked using the size of nodes as illustrated in Figure 4.

Based on the analysis of eigenvector centrality, it is apparent that there were 5 tourist attractions with higher centrality values than the others. As a result, these 5 tourist attractions were defined as primary tourist attractions, namely Khamchanod, Talaybuadang, Banchiang national museum, Watpabantad and Watpaphukon. Meanwhile, 17 tourist attractions were assigned as secondary tourist attractions, including Huailuang dam, Khoinang waterfall, Hintang waterfall, Udonthani city museum, Phufoilom, Wangsammor forest park, Watthamsumonthaphaowana, Watpadongrai, Watpothisomphon, Watphuthongthepnimit, UD town(lifestyle mall), Nongprachak public park, Ho Chi Minh educational and tourism historical site, Huaitatkha reservoir, Nayung-Namsom national park, Than-ngam waterfall and Phuphrabat historical park. Finally, the other 8 community and local business tourist spots included Dose factory, Gray cabin, Option coffee bar, The good day café, Banna café, Phaeangnamphan, Suansittikorn and Khiriwongkot village.

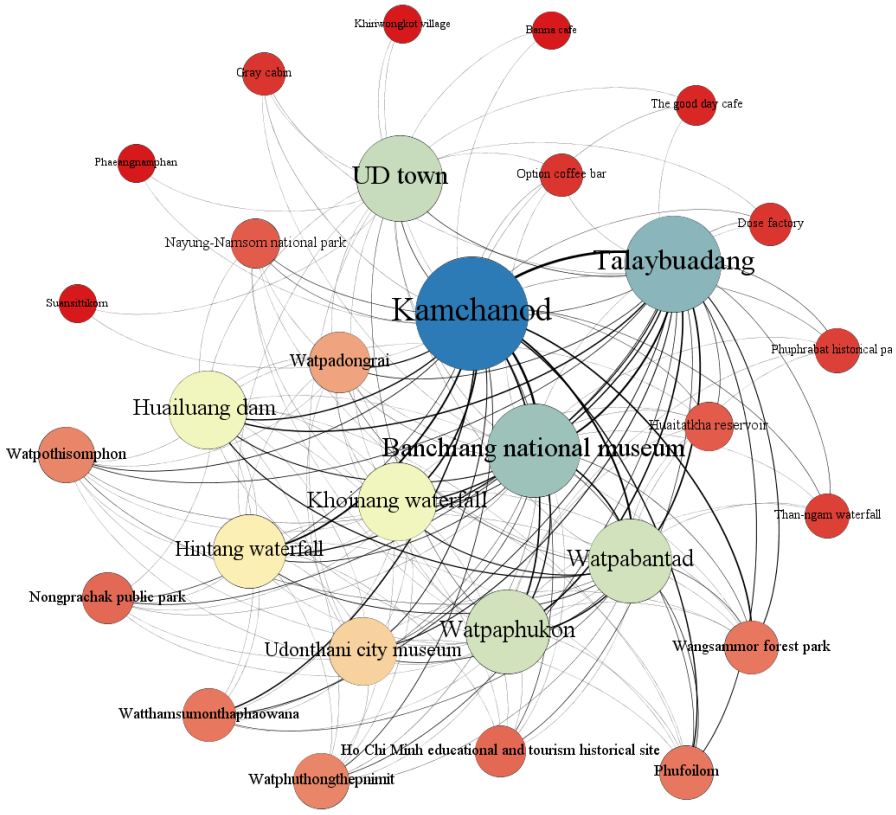

Figure 4 The eigenvector centrality according to the size of nodes of tourist attractions

4.2 Travel Routes

Considering the centrality of the network of tourist attractions in Udonthani, there were 5 primary tourist attractions, 17 secondary tourist attractions and 8 community and local business attractions. Afterwards, the research team and communities had a meeting together and developed travel routes based on the data and the tourists' preference, and each route must have a close centrality value and can be traveled within one day. As a result, 16 travel routes were developed as follows:

1) Temples tour and enjoy nature includes Khamchanod, Talaybuadang, Huailuang dam, Nayung-Namsom national park and Watpaphukon.
2) Temples tour, enjoy riding E-tak tractor and water adventure includes Phaeangnamphan, Khamchanod, Talaybuadang, Huaitatkha reservoir and Khiriwongkot village.
3) Food and temples tour includes Dose factory, Option coffee bar, Banna café, Talaybuadang and Khamchanod.
4) Temples tour and lotus sightseeing includes Watpabantad, Watphuthongthepnimit, Talaybuadang, Watthamsumonthaphaowana and Khamchanod.
5) Temples tour and let's ride a duck boat includes Khamchanod, Nongprachak public park, Watpothisomphon, Watphuthongthepnimit and Talaybuadang.
6) Traces of heritage tour includes Khamchanod, Banchiang national museum, Talaybuadang, Ho Chi Minh educational and tourism historical site and Phuphrabat historical park.
7) Enjoy Udonthani city like a local includes Khamchanod, Banchiang national museum, Udonthani city museum, Talaybuadang and Wangsammor forest park.
8) Adventure and temples tour includes Hintang waterfall, Khoinang waterfall, Than-ngam waterfall, Talaybuadang and Khamchanod.

9) Fun-Filled vacation includes Phaeangnamphan, Khamchanod, Talaybuadang, Phufoilom and Huailuang dam.
10) Temples tour and bon appetit includes Khamchanod, Watpadongrai, Talaybuadang, The good day café and Grey cabin.
11) Amazing garden and city tour includes Khamchanod, Talaybuadang, UD town (lifestyle mall), Nongprachak public park and Suansittikorn.
12) Temples tour and city sightseeing includes Khamchanod, Nongprachak public park, UD town (lifestyle mall), Watpabantad and Talaybuadang.
13) Bon appetit and café hopping includes The good day café, Dose factory, Grey cabin, Option coffee bar and Banna café.
14) Adventure tour and roaming around includes Khiriwongkot village, Nayung-Namsom national park, Phaeangnamphan, Huaitatkha reservoir and Hintang waterfall.
15) Let's travel and learn includes Phuphrabat historical park, Ho Chi Minh educational and tourism historical site, Udonthani city museum, Banchiang national museum and Wangsammor forest park.
16) Let's make merit and be happy includes Watpaphukon, Watpothisomphon, Watpabantad, Watphuthongthepnimit and Watthamsumonthaphaowana.

All 16 travel routes covered 30 tourist attractions. What's more, primary tourist attractions, secondary tourist attractions and community and local business attractions were appropriately assigned to each route. It is important to note that too many travel routes can render tourists unable to make decisions on the routes. Thus, it was resolved that 16 travel routes were appropriate and adequate.

4.3 Android Application

Based on a review of tourist attractions in Udonthani, the researchers learned some details of tourist attractions, travel routes and types of tourist attractions. Consequently, the information was presented through the development of the smartphone application for secondary city tourism in Udonthani using Android Studio 3.5.3. The application provides tourists with information regarding 30 tourist attractions and the shortest route from one attraction to another as well as with suggestions of routes to all those attractions. In addition, its "One Day Trip" menu suggests routes for 5 popular primary tourist attractions in Udonthani, accompanied by secondary tourist attractions and community and local business attractions, as shown in Figure 5.

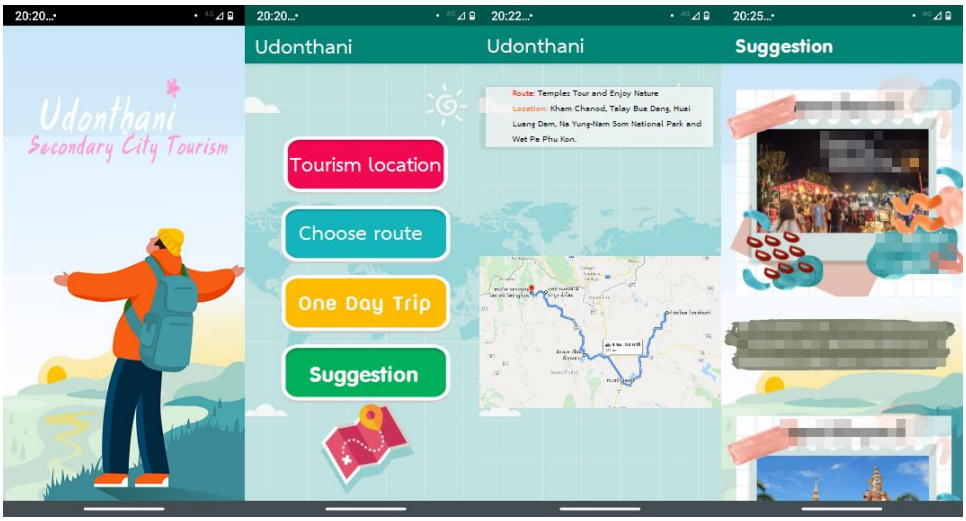

Figure 5 The smartphone application for secondary city tourism in Udonthani

The application also comes with the “Tourism location” menu which presents information about all 30 tourist attractions; in the meantime, the “Choose route” menu suggests the best route between 2 tourist attractions, while the “Suggestion” menu suggests stops and interesting activities. The current version of this application is available only in Thai. However, the future version will be available in English and Chinese in preparation for foreign tourists’ travel after the COVID-19 situations improve and Thailand is ready to admit foreign visitors to the country.

4.4 Satisfaction

After officially launching the application named “Tiew Muang Rong Udonthani”)Secondary City Tourism in Udonthani) on Google Play Store for the period of 3 months, the research team undertook a field study to explore 400 tourists in Udonthani’s satisfaction towards the application. They were asked to plan a trip using the application. Subsequently, they were asked to complete the questionnaires about their satisfaction; specifically, the questionnaires consisted of 15 items divided into 4 aspects, namely contents (5 items), usage (3 items), design (3 items) and satisfaction towards travel routes in the “One Day Trip” menu (3 items). The results indicated that the contents were at a high level of satisfaction (a mean score of 4.44), the usage at the highest level (a mean score of 4.52), the design at a high level (a mean score of 4.38) and the satisfaction towards routes in the “One Day Trip” menu at the highest level (a mean score of 4.55). Hence, it can be concluded that the sample group’s overall satisfaction towards the application was at a high level (a mean score of 4.48).

5. Discussion

The research team collaborated with the communities throughout all stages of this research, including data collection, selection of tourist attractions, travel route and application development and satisfaction survey and interviews with the tourists. Consequently, the application “Tiew Muang Rong Udonthani” was successfully developed according to the communities’ needs; moreover, tourists had a high level of satisfaction towards the application. As regards social network analysis, it served as an effective instrument for developing 16 travel routes appropriately, and the users had the highest level of satisfaction. Thus, it can be concluded that the successful local development in compliance with the objectives of this project lies in the integration of knowledge, technology and communities.

6. Conclusion

This research was intended to develop new travel routes in Udonthani so as to improve tourism in Udonthani and neighboring provinces and to develop a new travel platform using websites and applications as a medium connecting communities with tourists with ease. The present study employed social network analysis. Tourist attractions and activities in Udonthani were determined as nodes in the network. In addition, it investigated travel behavior among 400 tourists to serve as edges between each node so as to establish a travel network connecting tourist spots in the province in which Khamchanod and Talaybuadang were primary tourist attractions. Social network analysis was then conducted; as a result, there were 5 main tourist attractions, 17 secondary tourist attractions and 8 community and local business tourist spots. Despite that, the results indicated that the eigenvector centrality score was most consistent with the sample group's satisfaction level. Subsequently, the research team developed travel routes each with primary tourist attractions, accompanied by secondary tourist attractions and community and local business tourist spots. More importantly, all travel routes must have close eigenvector centrality values. Consequently, there were 16 suitable travel routes. Once 16 travel routes were established, the satisfaction among 400 tourists was investigated. It was discovered that the tourists' satisfaction towards all 16 travel routes was at the highest level with a mean score of 4.55 and a standard deviation of 0.53. Afterwards, the researchers presented all 16 travel routes via the Android application named "Tiew Muang Rong Udonthani")Secondary City Tourism in Udonthani) on Google Play Store. The satisfaction of 400 tourists was at a high level with a mean score of 4.48 and a standard deviation of 0.63.

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