



International Journal Of
**Recent Scientific
Research**

ISSN: 0976-3031

Volume: 7(1) January -2016

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THE OFFICIAL PUBLICATION OF
INTERNATIONAL JOURNAL OF RECENT SCIENTIFIC RESEARCH (IJRSR)
<http://www.recentscientific.com/> recentscientific@gmail.com



ISSN: 0976-3031

Available Online at <http://www.recentscientific.com>

International Journal of Recent Scientific Research
Vol. 7, Issue, 1, pp. 8558-8560, January, 2016

International Journal
of Recent Scientific
Research

RESEARCH ARTICLE

OPTIMISATION OF KANCHIPURAM DIVYADESAM NETWORK – A NOVEL ALGORITHMIC APPROACH

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ARTICLE INFO

Article History:

Received 16th October, 2015
Received in revised form 24th
November, 2015
Accepted 23rd December, 2015
Published online 28th
January, 2016

Key words:

Kanchipuram, divyadesam, optimal route,
network, darshan time, travelling time.

ABSTRACT

This paper aims at designing a network model for a tour of Divyadesam temples in Kanchipuram city so as to find the critical path which minimises the time travelled and the duration of darshan. Determining the shortest route to the places from the preferred starting point will be both timesaving and economical. This study also intends to recommend the best time slots and the optimal sequence to the pilgrims for a smooth visit of the temples, depending on the place at which an individual starts.

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INTRODUCTION

Divyadesams are the famous SriVaishnava shrines which form the focus of all the Divyaprabandhams composed by the divine saints called Alvars. There are 108 Divyadesams in all, of which only 106 are considered to be in this material world; one is located in Nepal and the remaining 105 are located in India, primarily in the south. These temples, considered to be the 'sanctum sanctorum' of all SriVaishnava places of worship, are classified according to the regions in which they are situated: Chozha Nadu, Pandiya Nadu, Malai Nadu, Nadu Nadu, Thondai Nadu, Vada Nadu and Out of World (Thiruparkadal and Paramapadam). Among these, Thondai Nadu (present Kanchipuram, Chennai and surrounding regions) alone houses around 22 Divyadesams.

Study Area

Of the 22 Divyadesams mentioned above, 14 temples are situated in Kanchipuram city itself. We consider these 14 temples for our study. We further divide these temples into two groups; temples at Vishnu Kanchi (5 temples) and temples at Siva Kanchi (9 temples).

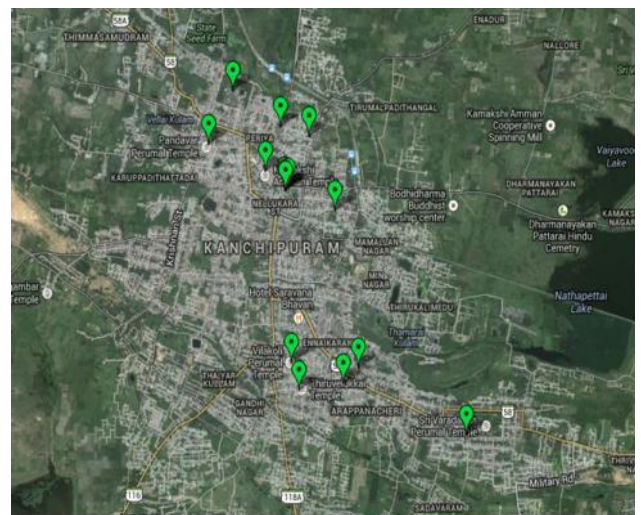


Fig. 1 Locational Map of the study area.
Courtesy: Google Map

We begin with the list of Divyadesams in the two regions.

Vishnu Kanchi: The list of temples at Vishnu Kanchi area are, Sri VaradarajaPerumal Temple (Thirukkachi – Athigiri), Sri AstabhujaPerumal Temple (Ashtabuyakaram), Sri

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YathokthakariPerumal Temple (Thiruvekha), Sri AzhagiyaSingarPerumal Temple (Thiruvelukkai), Sri DeepaprakasaPerumal Temple (Thiruthanga).

Siva Kanchi: The list of temples at Siva Kanchi are, Sri VaikundaPerumal Temple (ThiruparameswaraVinnagaram), Sri UlagalandaPerumal Temple (Thiruoorageam), which includes 3 more (Thiruneeragam, Thirukaragam and Thirukaarvannam) in the same premises, Sri AdiVarahaPerumal Temple (Thirukkalvanoor) located at Sri KanchiKamakshi Amman Temple premises, Sri PavalaVannaPerumal Temple (ThirupavalaVannan), Sri NilathingalThundaPerumal Temple (ThiruNilathingalThundam) located at Sri Ekambaranathar Temple premises, Sri PandavaThoothaPerumal Temple (Thirupadagam).

Objectives

The following objectives have been set for the study

1. To visit all the temples within the shortest possible time.
2. To perform the tour of the temples by minimising the travelling and darshan time.
3. To find an optimal sequence of visiting the temples for every starting node.

NETWORK MODEL OF DIVYADESAMS

In this study, the temples are viewed as a network by considering each temple as a 'node' and the roads connecting the nodes as 'edges'. The travelling time (t) along a connecting road is assigned as the weight for the edge and the darshan time (d) in the temple as the weight for the node.

Assumptions and Limitations of The Study

This study is done for an ordinary day assuming that the temple does not have a large crowd. If it is a festival day, the darshan time (d) certainly varies. The travelling time (t) connecting two adjacent nodes is the actual transit time by means of a two-wheeler / auto rickshaw, the traffic being normal. Identically, if the individuals prefer to visit the temples by a car or any other public transport, a similar prototype can be used with the travelling time changed accordingly.

Block Time: Time duration during which the pilgrims are not allowed for darshan, in order to enable the priests to perform daily temple rituals for the principal deity.

Shortest Route Problem: Problem of finding a path between any two nodes such that the sum of the weights of the edges are minimised.

The temples have different opening and closing times which differ in minutes but have a common period. For the simplification of the study, we have idealised the opening time, closing time and block time to be same for all the temples. As the solution of finding the optimal sequence is being programmed by C Language, difference in timings can be incorporated for the execution of the same model for different entries.

The darshan time (d) for all the temples are similarly assumed to be same: Morning: 7.00 a.m. to 9.30 a.m. and 10.00 a.m. to 12.00 p.m., Evening: 4.00 p.m. to 6.30 p.m. and 7.00 p.m. to 8.30 p.m. The block timings are, morning 9.30 a.m. to 10.00 a.m. and evening 6.30 p.m. to 7.00 p.m. of duration 30 minutes.

Network Model of Vishnu Kanchi Divyadesam Temples

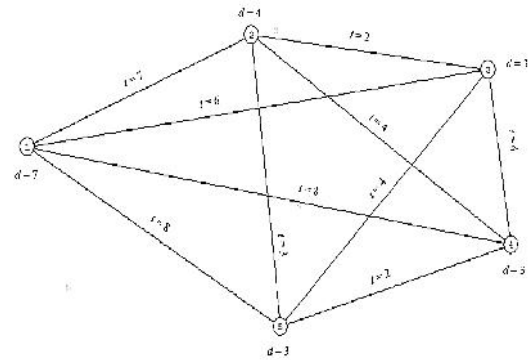


Fig. 2 d – darshan time, t – travelling time
1. Thirukkachi, 2. Ashtabuyakaram, 3. Thiruvekha, 4. Thiruvelukkai, 5. Thiruthanga

Network Model of Siva Kanchi Divyadesam Temples

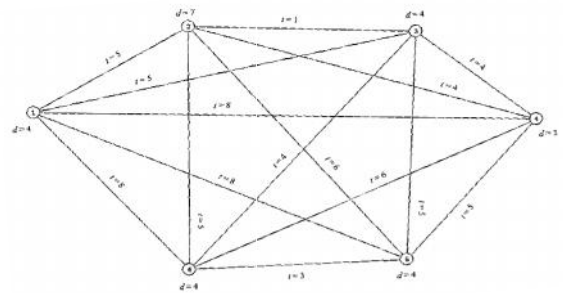


Fig. 3 d – darshan time, t – travelling time
1. ThiruparameswaraVinnagaram, 2. Thiruoorageam (includes 3 more), 3. Thirukkalvanoor, 4. Thirupavala Vannan, 5. ThiruNilathingalThundam, 6. ThiruPadagam

Fig.2 and Fig. 3 given above, representing the networks of the temples located in the regions Vishnu Kanchi and Siva Kanchi conforms to the geographical locations of the temples in the matters of adjacency of the nodes and accessibility; but it neither defines the actual map of their position nor is to scale.

Algorithm

The networks thus defined are intended to find the optimal sequence and the minimum duration that covers all the temples in the two regions by considering the travelling time (t) over the edges and the darshan time (d) at the nodes. The novelty of the model lies in the fact that it has weights at the nodes. As this problem is not solvable by any existing algorithm, a new algorithm has been developed in this paper to find the solution of this particular problem. The darshan intervals (07.00, 09.30), (10.00, 12.00), (16.00, 18.30), (19.00, 20.30), are represented by (O_1, C_1) , (O_2, C_2) , (O_3, C_3) and (O_4, C_4) , which are called first, second, third and fourth levels respectively. There may be more levels during special days and festival days which can be solved similarly.

Algorithm

- Step 1:** Start at any node (preferably at level 1).
- Step 2:** Finish darshan.
- Step 3:** Look for other nodes in the same level wherein $(t + d)$ fits in (O, C) . If there are more such nodes, choose the one where $t + d$ is smaller (in the same level).
- Step 4:** If no such node is available in the level, look for the next level. If there is a tie choose the one where $(t + d)$ is nearer to C .
- Step 5:** Go to that node, finish darshan.
- Step 6:** If there is no more node to visit, then stop.
- Step 7:** Otherwise, go to Step 3.

This algorithm works for any tourism model having weights at the nodes and on the edges.

Optimal Sequence of Temples

Based on the algorithm, a C – Program has been developed by the authors to find the optimal sequence for a tour of the temples in each region resulting in minimum duration for every starting node. The study also gives best time slots to perform the tour for achieving the minimum duration.

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Divya Desams at Vishnu Kanchi
1 - Sri Varadaraja Perumal Temple (Thirukkochi mthigiri)
2 - Sri Sathishanjan Perumal Temple (Sathishanjanam)
3 - Sri Yathakthabari Perumal Temple (Thirusekha)
4 - Sri Narasinga Perumal Temple (Thiruvoluksai)
5 - Sri Deepaperkasa Perumal Temple (Thiruthoka)

Temple Open Timings
Morning: 7.00 a.m to 12.00 p.m. Evening: 4.00 p.m to 8.30 p.m with blocks from
9.30 a.m to 10.00 a.m & 6.30 p.m to 7.00 p.m

Shortest Path with Minimum Duration
1-2-3-4-5 : 33 minutes
2-5-4-3-1 : 35 minutes
3-2-4-5-1 : 35 minutes
4-5-2-3-1 : 33 minutes
5-4-2-3-1 : 31 minutes

Preferred Time Slots to achieve Minimum Duration
Morning: 7.00 a.m to 8.45 a.m 10.00 a.m to 11.30 a.m
Evening: 4.00 p.m to 5.45 p.m 7.00 p.m to 8.00 p.m

If you start other than the preferred time slot, the duration will be increased
with the block time or you could miss some temples.
    
```

Fig. 4 Program output – Vishnu Kanchi region with total description

```

Divya Desams at Siva Kanchi
1 - Sri Vaikunda Perumal Temple (Thiruparankundam Ummaganam)
2 - Sri Ulagalanda Perumal Temple (Thiruvazhagar, 3 miles)
3 - Sri Adikavala Perumal Temple (Thirukavayana)
4 - Sri Pavala Umma Perumal Temple (Thirupavala Umma)
5 - Sri Nilakalinga Thunda Perumal Temple (Thirunilakalinga Thundam)
6 - Sri Pandava Theetha Perumal Temple (Thirupandavam)

Temple Open Timings
Morning: 7.00 a.m to 12.00 p.m. Evening: 4.00 p.m to 8.00 p.m with blocks from
9.30 a.m to 10.00 a.m & 6.15 p.m to 6.30 p.m

Shortest Path with Minimum Duration
1-2-3-4-5-6 : 49 minutes
2-4-5-3-1 : 52 minutes
1-6-5-4-2-1 : 52 minutes
4-5-6-3-2-1 : 49 minutes
1-4-3-2-1 : 50 minutes
6-5-4-3-2-1 : 49 minutes

Preferred Time Slots to achieve Minimum Duration
Morning: 7.00 a.m to 8.45 a.m 10.00 a.m to 11.15 a.m
Evening: 4.00 p.m to 5.15 p.m 6.45 p.m to 7.15 p.m

If you start other than the preferred time slot, the duration will be increased
with the block time or you could miss some temples.
    
```

Fig. 5 Program output – Siva Kanchi region with total description

How to cite this article:

Radhakrishnan V K and Venugopal T.2016, Optimisation of Kanchipuram Divyadesam Network – A Novel Algorithmic Approach. *Int J Recent Sci Res.* 7(1), pp. 8558-8560.

Any other starting time apart from those time slots, will cause the visitor to get stuck over a block resulting in an increase of the time spent at the block. It is also likely that some temples are missed. Fig. 4 and Fig. 5 represent the program output to visit the temples in the two regions respectively.

CONCLUSION

This study suggests an optimal tour programme that minimises the total duration of tour for the two regions separately. If an individual wants to perform the tour of both regions, he has to start from the node at the far end of one region and finish with the node at the far end in the opposite direction of the other region. The total duration of the tour of both regions together can be found by adding the minimum duration of the regions along with the time taken to reach from one zone to other zone, as the two zones are connected by a single edge.

Thus it is preferable to perform the tour in Vishnu Kanchi region starting from Sri Varadaraja Perumal Temple (node 1) along the optimal sequence ending at Sri Narasinga Perumal Temple (node 4); next, the single edge connecting the two regions should be traversed to reach Sri Ulagalanda Perumal Temple (Node 2) in the Siva Kanchi region so that the tour along the optimal sequence will end at Sri Vaikunda Perumal Temple (Node 1) with total minimum duration of $(33 + 52 + 10)$ 95 minutes. If started during the prescribed time slots, a pilgrim would be able to have darshan of all divyadesams in Kanchipuram city in one and half hours.

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T.SSN 0976-3031



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