iTour2.0: A Smart Tourism Application for Independent Mobility of Tourists

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Outline of the Talk

- Introduction

- Overview of Smart Tourism

- Related Research on Tourism Application

- Novel Contributions of Current Paper

- Proposed iTour2.0 Framework

- GeoFencing for Tourism

- Recommender System Overview

- Implementation & Results

- Conclusion & Future Research

Introduction

- Tourism is one of the driving factors of Smart Cities

- Huge Economic potential

- Plays an important role in the lives of citizens and stake holders

- Tourism rate is exponentially increasing every year

- Technology is a contributing factor for the development

GDP → 5% of World GDP

Services ← 30% of world's Exports of commercial services

Tourism

Employment → 6-7% of total employment

Global Exports ← One of top 5 export earners in over 150 countries
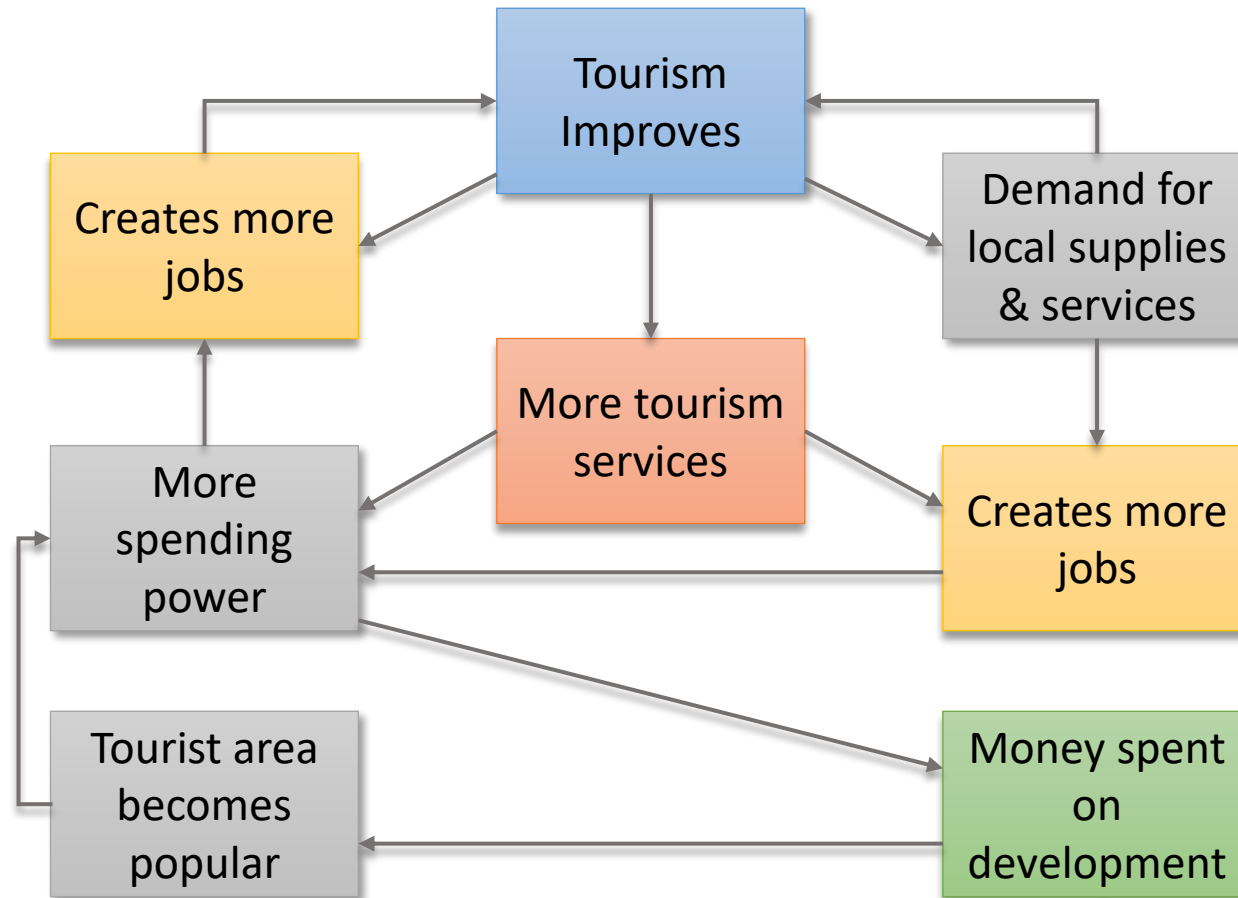
Economy → $1 trillion USD

Overview of Smart Tourism

Use of **Smart technologies** like ICT, IoT, Mobile Applications, Machine Learning etc. in **tourism activities** and **services.**
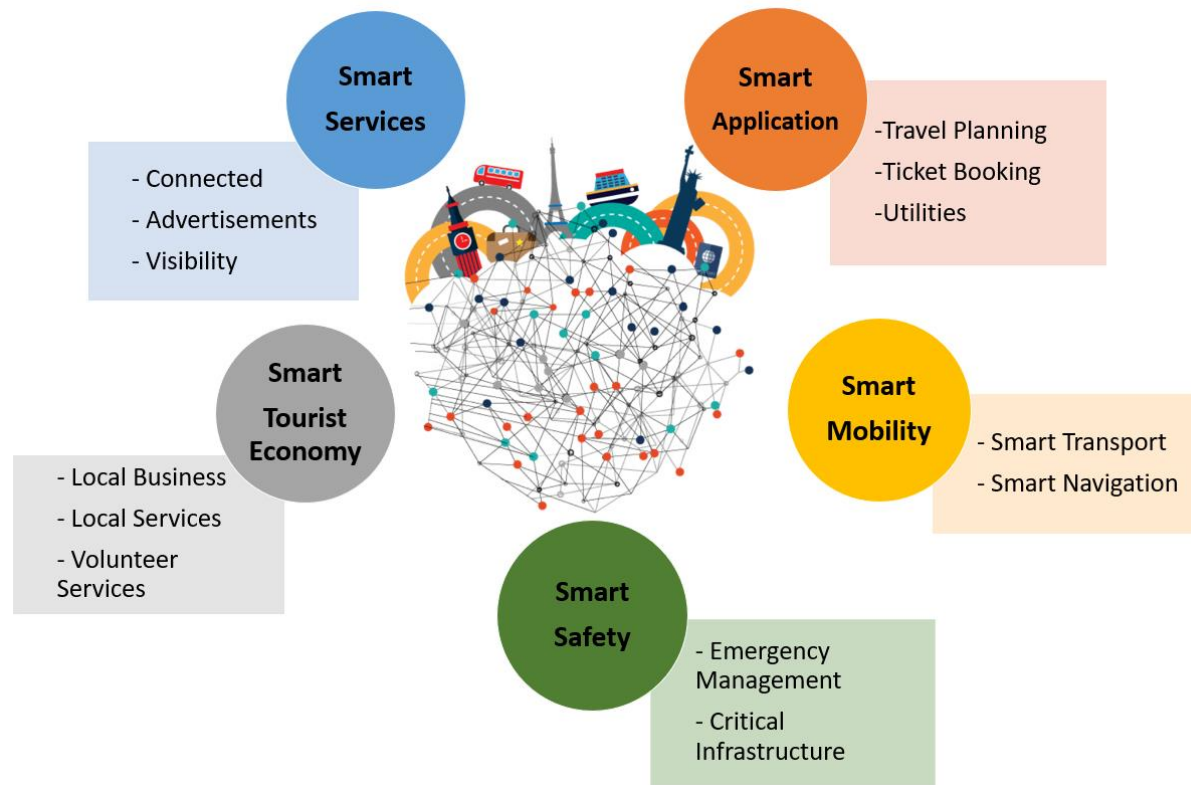
Impact of Tourism

Related Research on Tourism Applications

Technology	Feature	Area of Application
Location Based	Location Based Mobile Tourism Application using cloud platform	Cultural tourism in Malaysia, location-based PoI display and direction
NFC (Near Field Communication)	Smart Tourist Card, Mobile travel assistant	Provision of various services to tourists visiting Italian cities using NFC technology
Augmented Reality	ARCity, Augmented Reality in Tourism Mobile applications	To enhance Cultural tourism experience
Webservice	MyTourGuide.com, tourist web portal	Personalized tour information for travelers along the tourism life cycle which are planning stage, touring stage and reminiscing stage

Novel Contributions of Current Paper

- (LBS) Location based Services for tourism

- Geofencing for improving the user experience and business-centric approach

- Collaborative Filtering based recommender system through user feedback

- Reducing Internet data usage by displaying all the relevant information on the user console based on their location and choices

- The reduction in browsing time also reduces the cell phone battery usage

- Real-Time travel assistance, emergency services and volunteer services

Overview of features of iTour2.0

- Tourism experience with minimum effort, maximum security and comfort

- Beneficial for user and stake holder

- Real –Time services/ Trusted services

- Customized recommendations
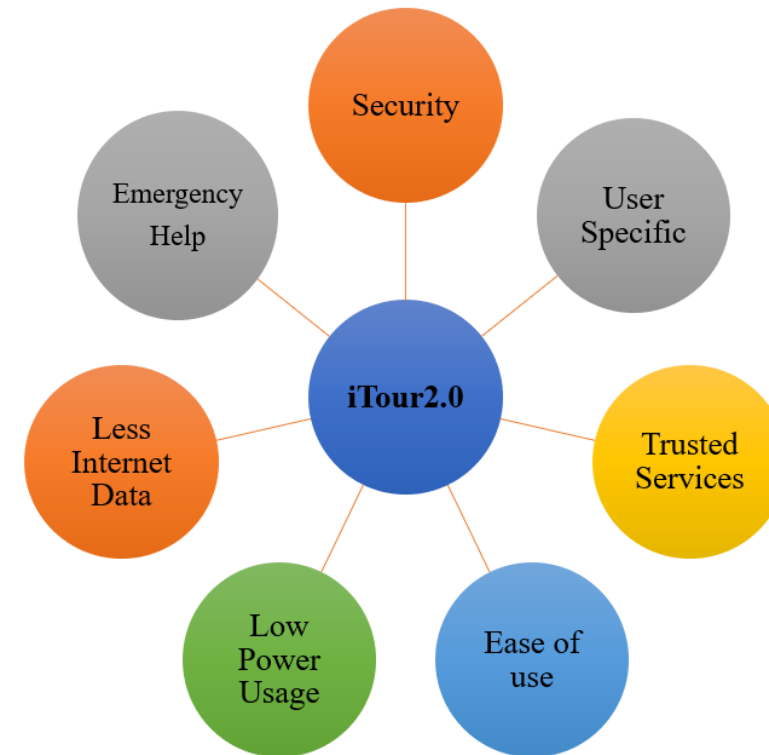
iTour2.0 Stake Holders

- The stakeholder - "any group or individual who can affect or is affected by the achievement of the organization's objectives"

- Stakeholder approach has been applied in many areas:
  - Rural development
  - Public management and
  - Tourism development

- Tourism Development is a collaboration between community, government, and business organizations

Advantages of Stake Holders

- Ease of Business

- Collaborative and connected

- Better Access to services

- Increase in employment

- Increase in earnings

- Better marketing

- Better Visibility
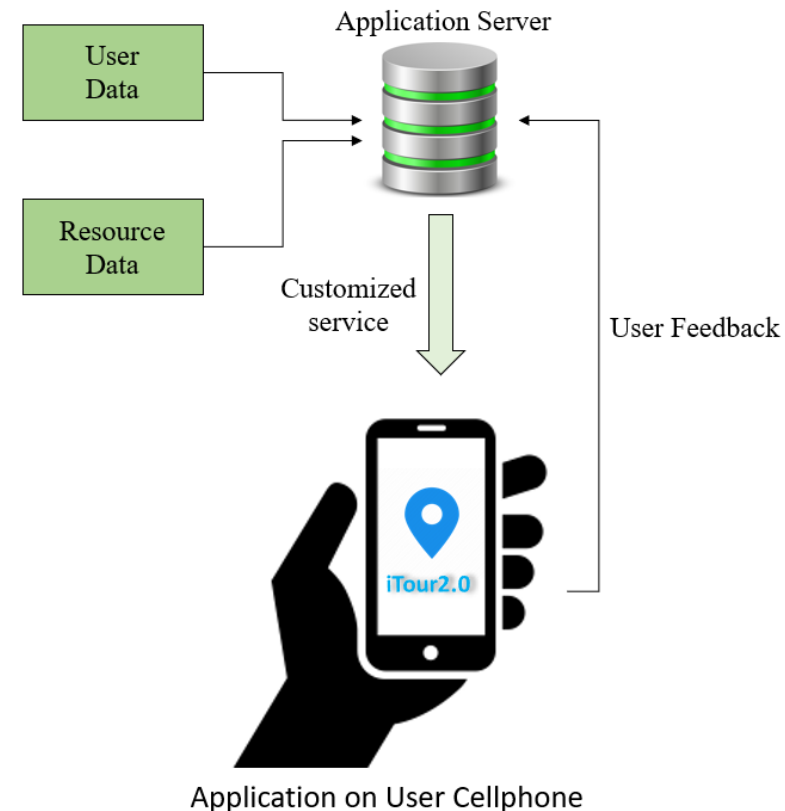
- Increase in size of customers
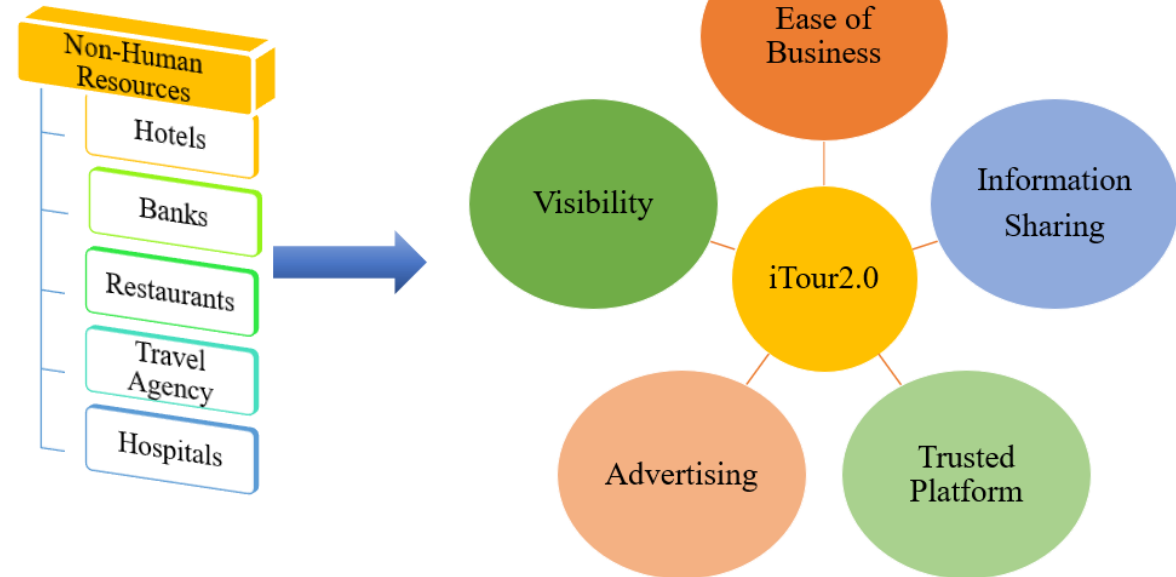
GeoFencing for Tourism

- Geofencing is a Location aware notification system

- A GPS based smart map or mobile application along with Geofencing can greatly enhance the user experience

- User will receive push notifications on their cellphones about the deals or other advertisements in their surrounding

- The stake holders can decide on the visibility and size of customers

Geofencing Overview
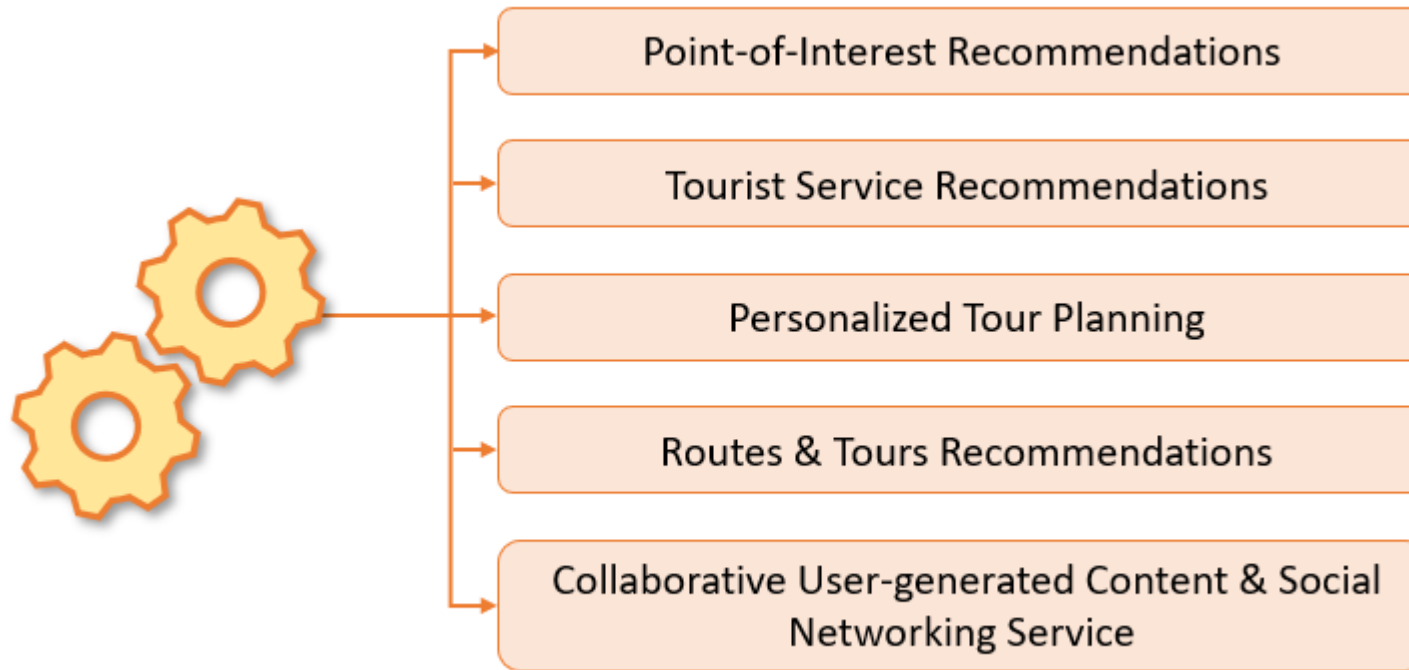
The notification system works on the geofences using the Google Location API and the beacons of the Smart Phones using Bluetooth technology

Application Server

User Data

Resource Data

Customized service

User Feedback

iTour2.0

Application on User Cellphone

Recommender System

- Recommender systems in tourism are classified as
  - LARS (Location Aware Recommendation System)
  - CARS (Context Aware Recommendation System) and
  - CBRS (Critique Based Recommender System)

- Context based recommendations are more user specific

- Interaction Media Context - User feedback in form of reviews, ratings, opinions and experiences

- Popular Social networking sites:
  - Facebook and Twitter - Text based
  - Instagram - Picture based and
  - YouTube - Video based

# Recommender System In Tourism

Point-of-Interest Recommendations

Tourist Service Recommendations

Personalized Tour Planning

Routes & Tours Recommendations

Collaborative User-generated Content & Social Networking Service

SVD based Recommendation System

- To tackle the issues of Big Data many Machine Learning and Data Mining techniques are being employed
  - Singular Value Decomposition (SVD)
  - Probability Matrix Factorization (PMF),
  - Non-Negative Matrix Factorization (NMF) etc.
- These methods improve the performance of the recommendation system
- SVD manages the scalability issue by reducing the dimensionality of the Recommender system and it can be used for prediction tasks

SVD Matrix
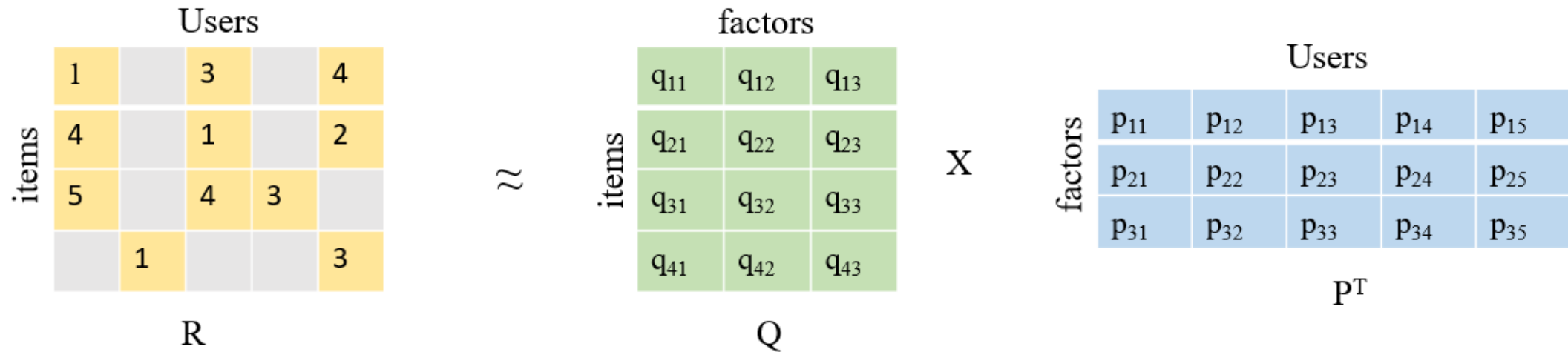
$$A = U\Sigma V^T$$

The above SVD equation can be used to map the matrices to rating matrix R and the item and user factors Q and P as shown below:

$$A=R, Q=U \text{ and } P^T = \Sigma V^T$$

SVD Algorithm Implementation

- To train the algorithm we have used data from:
    - 50 different users for
    - 10 different hotels with a total of
    - 500 ratings with preference rating
    - rate 1-5 and 0 for no preference/rating for the place

- To test the prediction accuracy for a large set of data, we used a 10K dataset

Results

- RMSE (Root Mean Squared error) and MAE (Mean Absolute Error) values obtained for a 5-fold Cross-Validation of the test data generated by splitting the data into test set and training set

- For an ideal model the RSME and MAE must be close to 0

	Fold 1	Fold 2	Fold 3	Fold 4	Fold 5	Mean
RMSE (testset)	0.6375	0.6022	0.6265	0.5958	0.573	0.607
MAE (testset)	0.2993	0.2771	0.2847	0.2757	0.2755	0.2825
Fit time	0.25	0.25	0.26	0.26	0.3	0.26
Test time	0.01	0.01	0.01	0.01	0.01	0

Output:

```
1142
[{'id': 5, 'hotel_name': 'Hilton', 'average_rating': 5}]
3.455982208351275
[{'id': 6, 'hotel_name': 'Paradise', 'average_rating': 4}]
```

Comparison Table of Various Algorithms

Algorithm	RMSE	MAE
SVD	0.946	0.733
SVD++	0.963	0.751
NMF	1.104	0.862
Slope One	1.104	0.862
k-NN	1.104	0.862
Centered k-NN	1.104	0.862
k_NN Baseline	0.956	0.743
Co-Clustering	1.104	0.862
Baseline	0.956	0.743
Random	1.623	1.341

Comaparative Table for State-of-the-Art Literature

| Research	Algorithm	Dataset	Context
Jia et al.	SVD++	Tmall Data	User, User actions
Fenza et al.	FCM	Users and POI	Location, User, User profile
Zao et al.	Item-Based Recommender	Video Website	User, Movies, ratings
Barathy et al.	SVD	MovieLens	Users, ratings
iTour2.0 (Current Paper)	SVD	Hotel Ratings	User, hotels, ratings

Comparative Table of State-of-the-Art Literature RMSE Values

Research	Algorithm	No of Records	RMSE
Jia et al.	SVD++	100,000	0.9116
Fenza et al.	FCM	1000	0.811
Zao et al.	Item-Based Recommender	800	1.057
Barathy et al.	SVD	100,000	0.939
iTour2.0 (Current Paper)	SVD	10,000	0.6375

Implementation of iTour2.0

- The iTour2.0 application is built on the Linux operating system using Python and Leaflet

- PostgreSQl – To create the relational databases

- PostGIS - To add the geospatial objects to the location data

- Leaftlet API and GeoJSON - For creating the interactive smart map

- Pandas - For manipulating the data for analysis

iTour2.0 Application
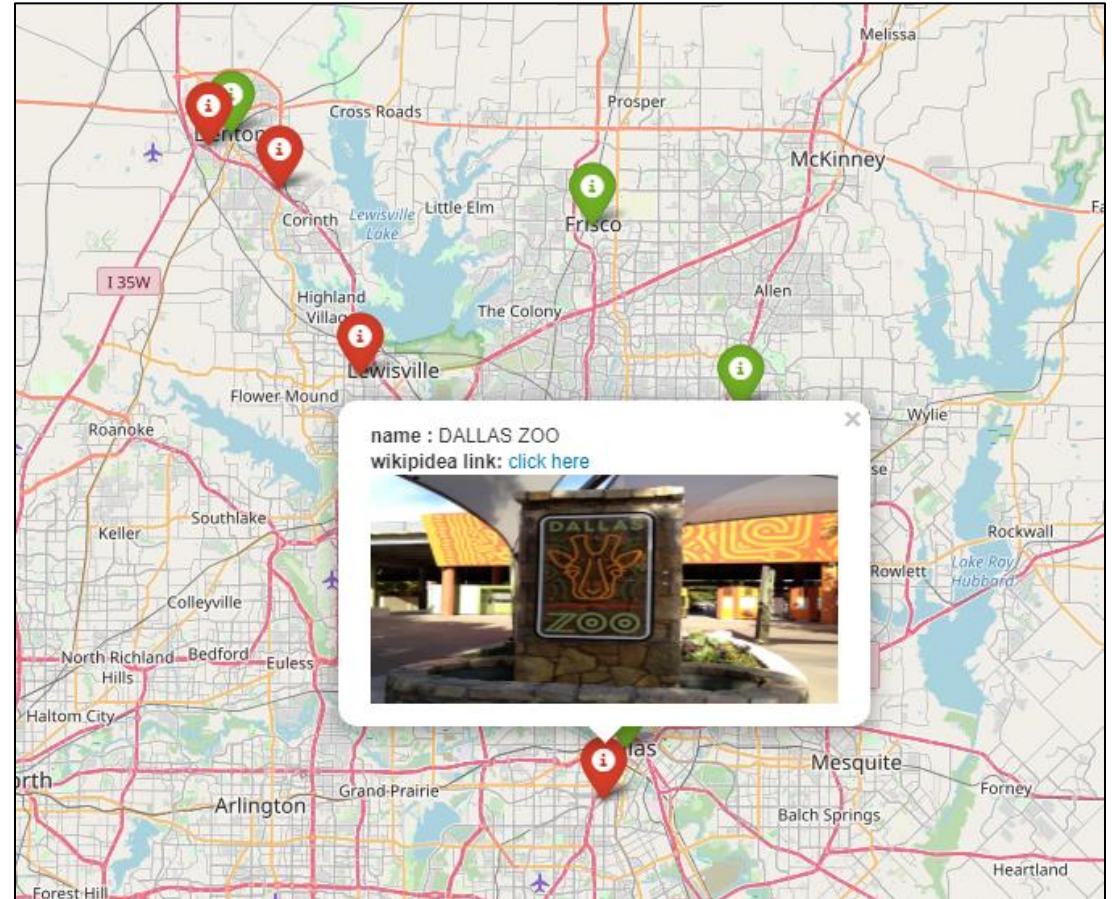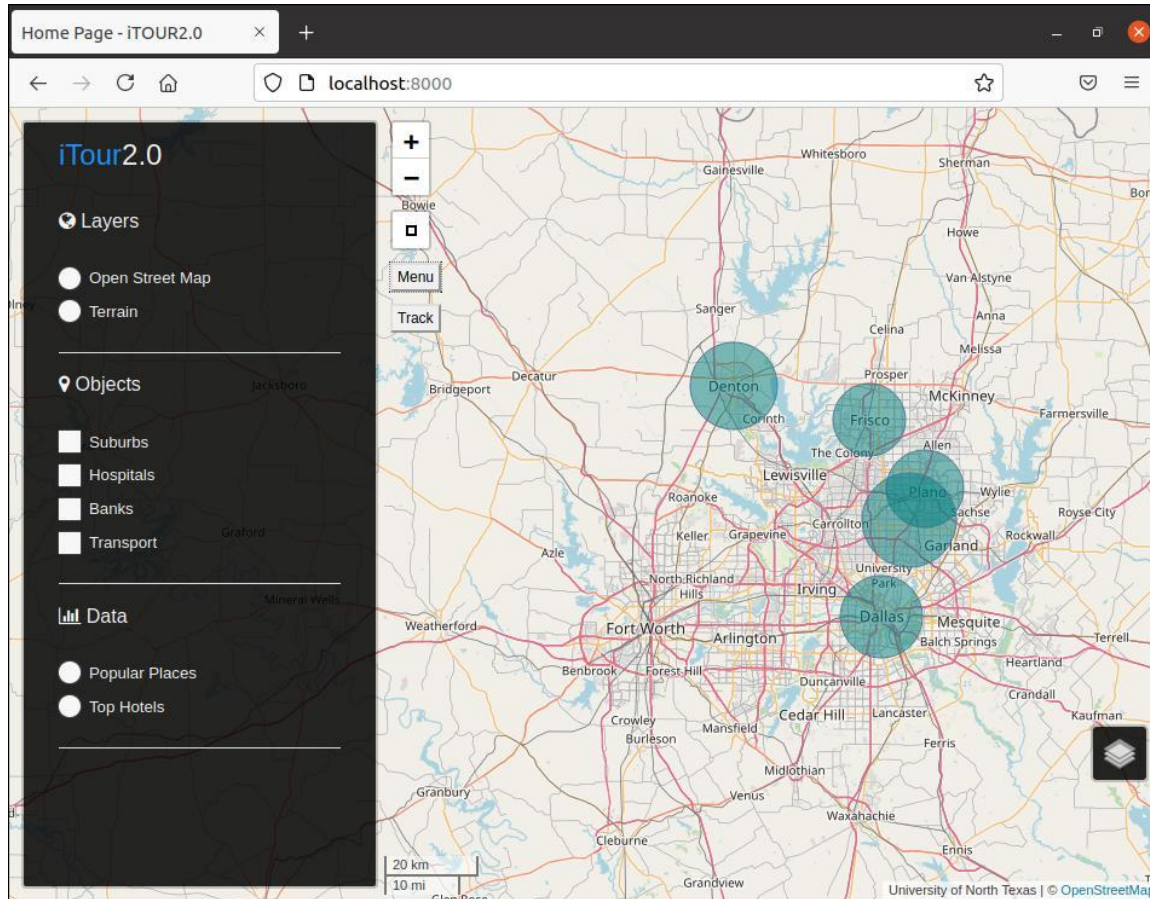
Statistics Table of Load Test

Requests	Executions			Response Times(ms)
Label	Samples	Fail	Error %	Average
Total	3000	0	0.00%	18.52
HTTP Request	1000	0	0.00%	27.84
HTTP Request-0	1000	0	0.00%	16.28
HTTP Request-1	1000	0	0.00%	11.43

Throughput and Network Statistics

Requests	Throughput	Response Times(ms)	Network(KB/sec)	
Label	Transactions/s	Average	Received	Sent
Total	30000	1712.13	285.3	37.97
HTTP Request	10000	2568.22	73.92	18.99
HTTP Request-0	10000	696.22	73.93	9.46
HTTP Request-1	10000	1871.93	73.95	9.53

Latency Vs Request
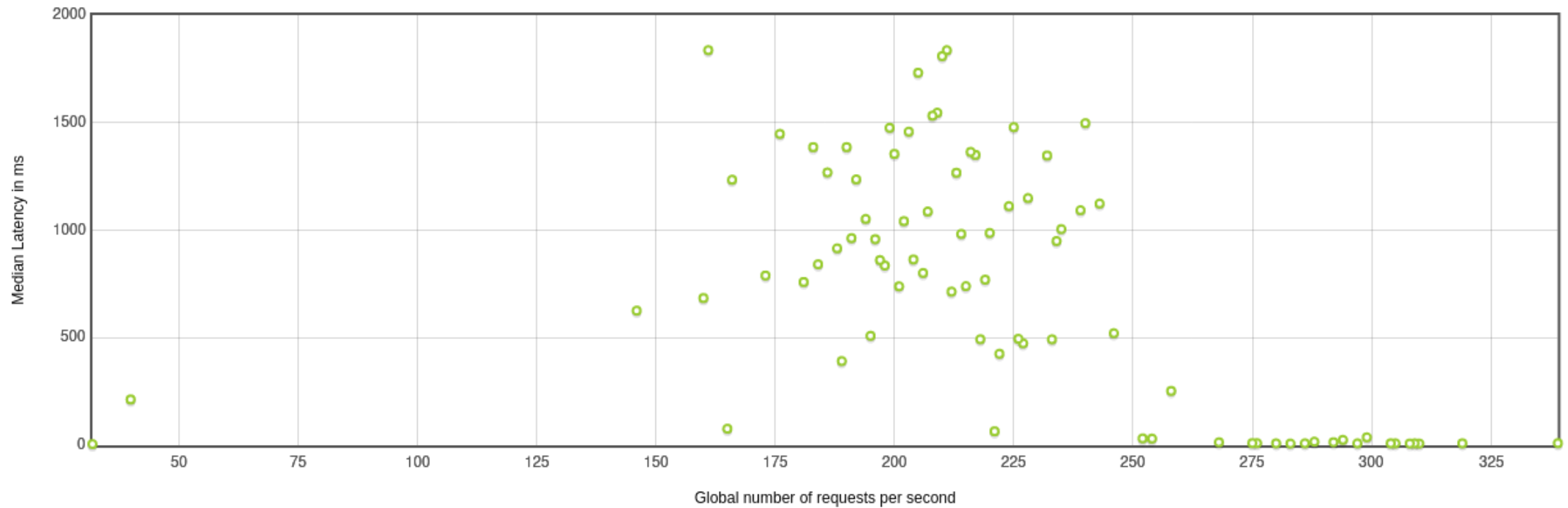
Time Vs Request Threads
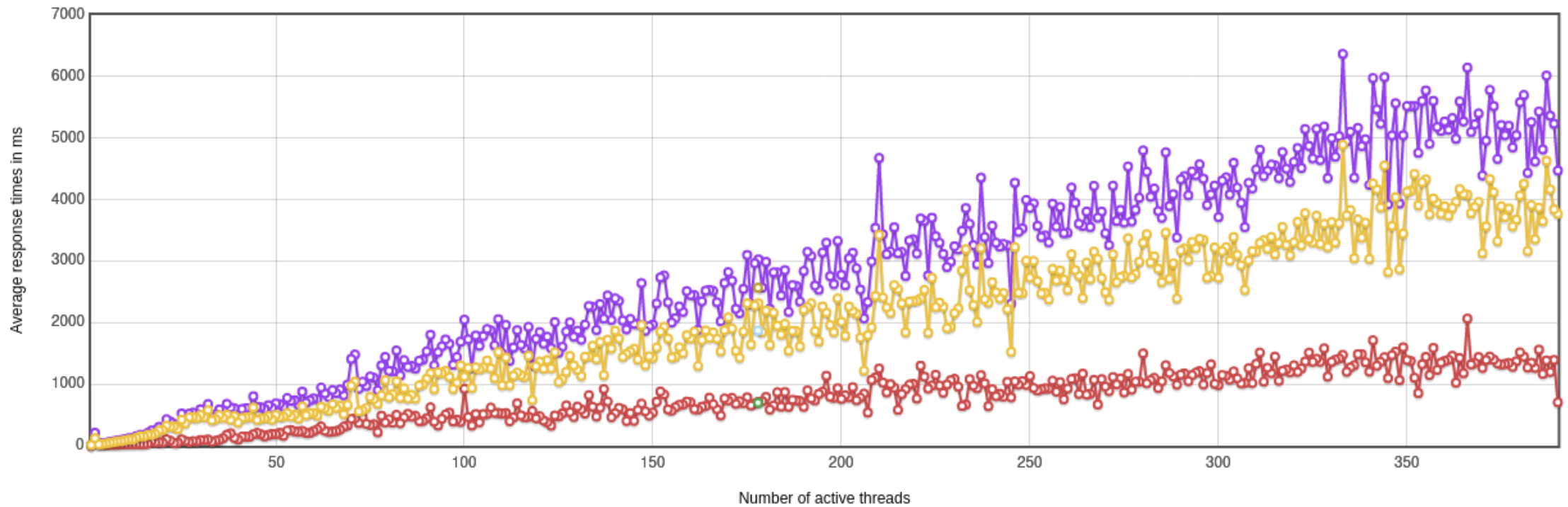
Conclusions

- Developments in tourism aid the economical growth

- The driving technologies of smart cities like ICT and IoT help to design better solutions for tourism-based applications

- Mobile applications within the IoT framework, like iTour2.0 help in safe and comfortable mobility of tourists to new places

- Essential tool to improve the way people travel and experience the social, cultural, recreational and commercial environments

Future Research

- Adding Geofencing to the tourism application for better marketing of local business

  - More exposure to the tourists about the commercial opportunities

- Resolve data privacy and security issues

- Bandwidth, Positioning availability issues

- By considering more observable contexts regarding a destination Location/City, like the current social/political/climate conditions the recommender system will be able to provide more information for tourism planning

Questions?

Thank you!