RecSys 2018

CNeRG IIT KGP

ComfRide - A Smartphone based Comfortable Public Route Recommendation

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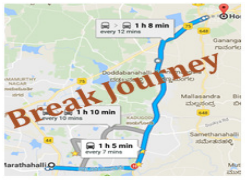
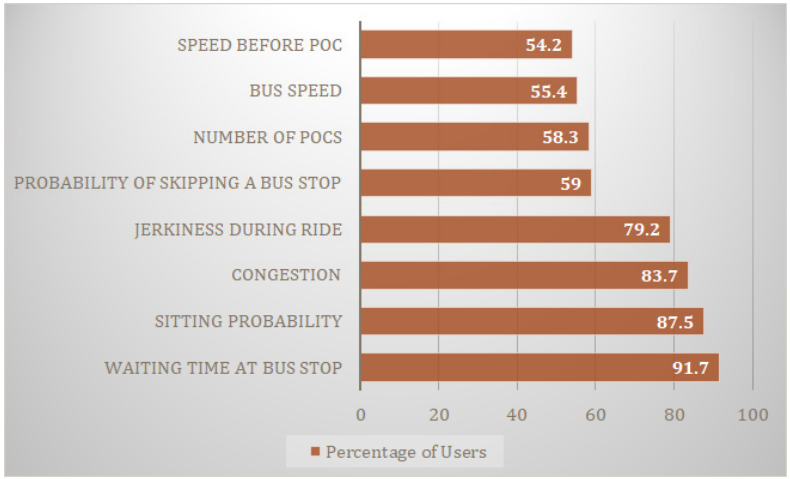
Understanding Commuter Comfort



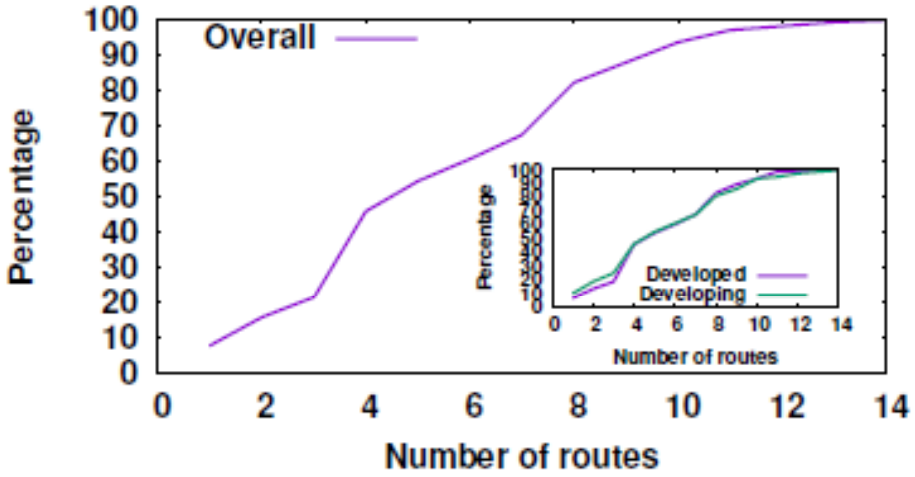
Different people have different comfort preferences which is seen all over the world.

Countries	Delay in Reaching			No seat			Bad Road		
	Regular	Occasional	Rarely	Regular	Occasional	Rarely	Regular	Occasional	Rarely
India	40.7	43.5	15.8	47.8	37.2	15	67.6	26.5	5.9
Nepal	80	20	0	40	60	0	60	40	0
Iran	12.5	62.5	25	62.5	25	12.5	62.5	37.5	0



Survey reveals importance of different features for commuters' comfort

Possibilities



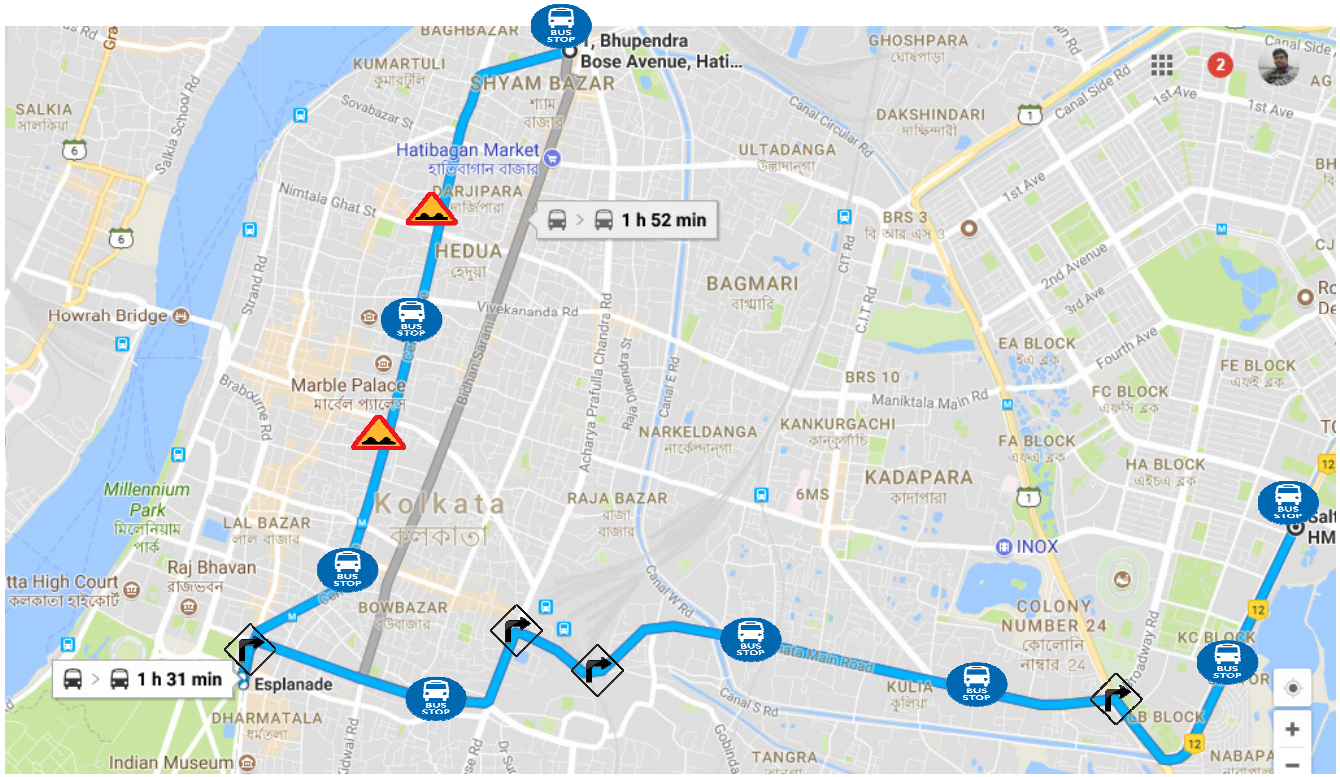
Cumulative Distribution of number of bus routes between random (source, destination) pairs calculated

- Location pairs from 50 capital cities around the world
- More than 60% of the source, destination pairs have at least 4 routes between them
- Approximately 25% have more than 8 routes

Objective

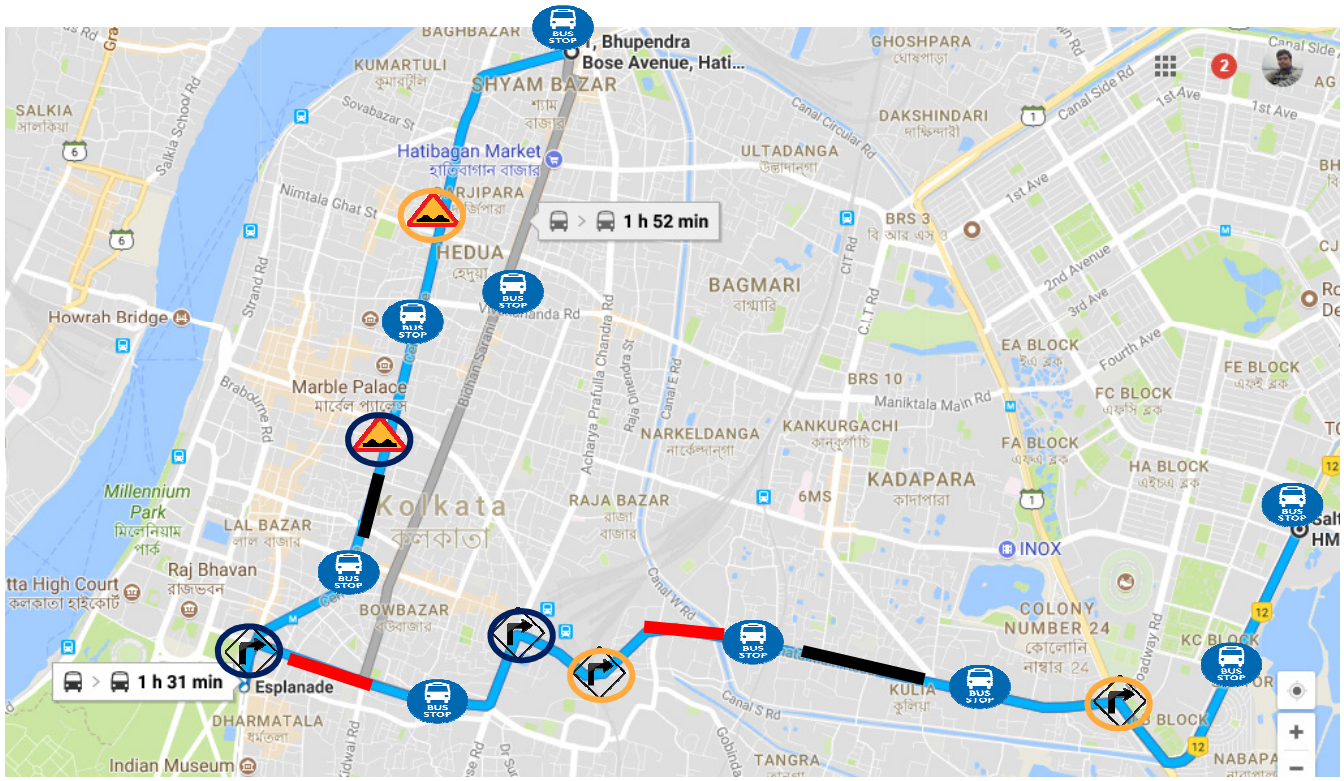
Develop an end-to-end smartphone based **personalized** bus route recommender system, which recommends the **most comfortable bus route** based on **commuters' comfort choices.**

Data Collection: Road Information



1. Speed Breakers
2. Turns
3. Bus Stops

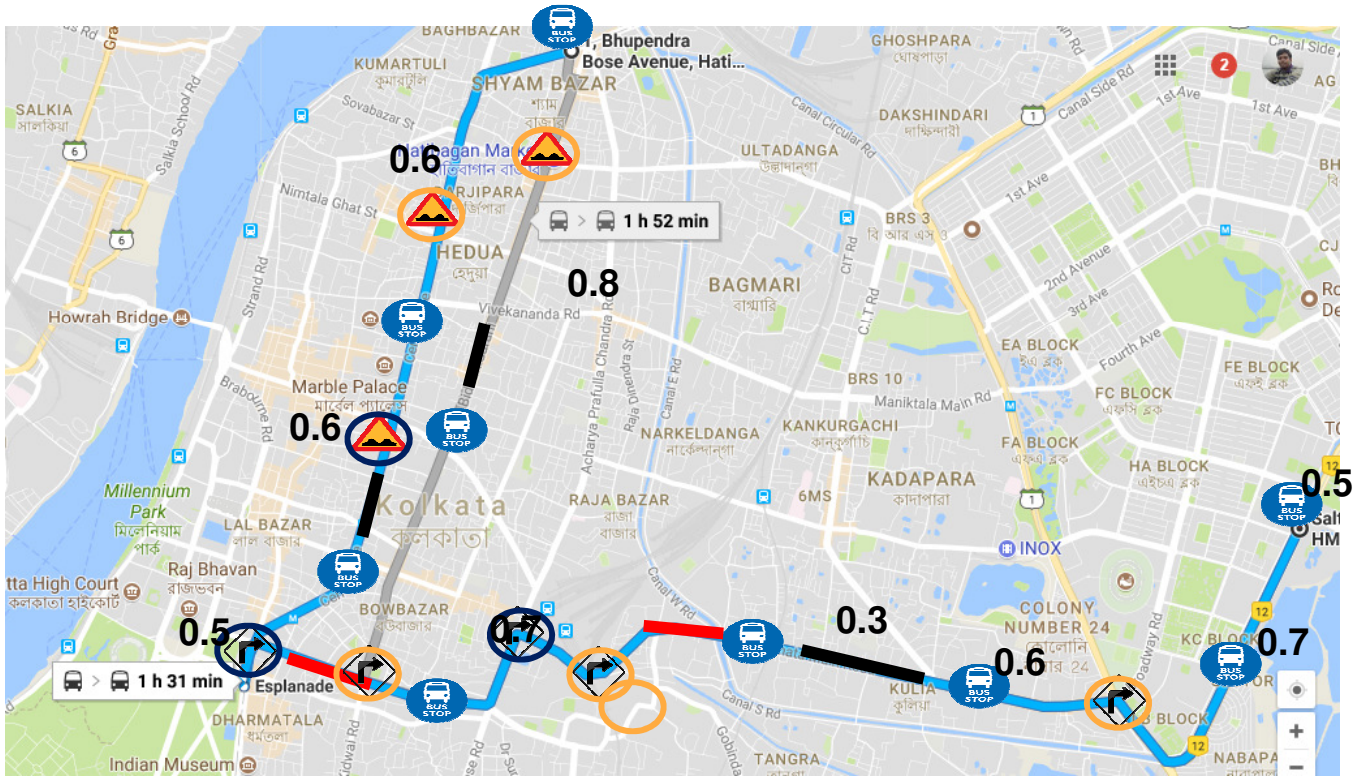
Data Collection: Route Information



1. Congestion
2. Jerkiness of Bus
3. Probability of getting a seat

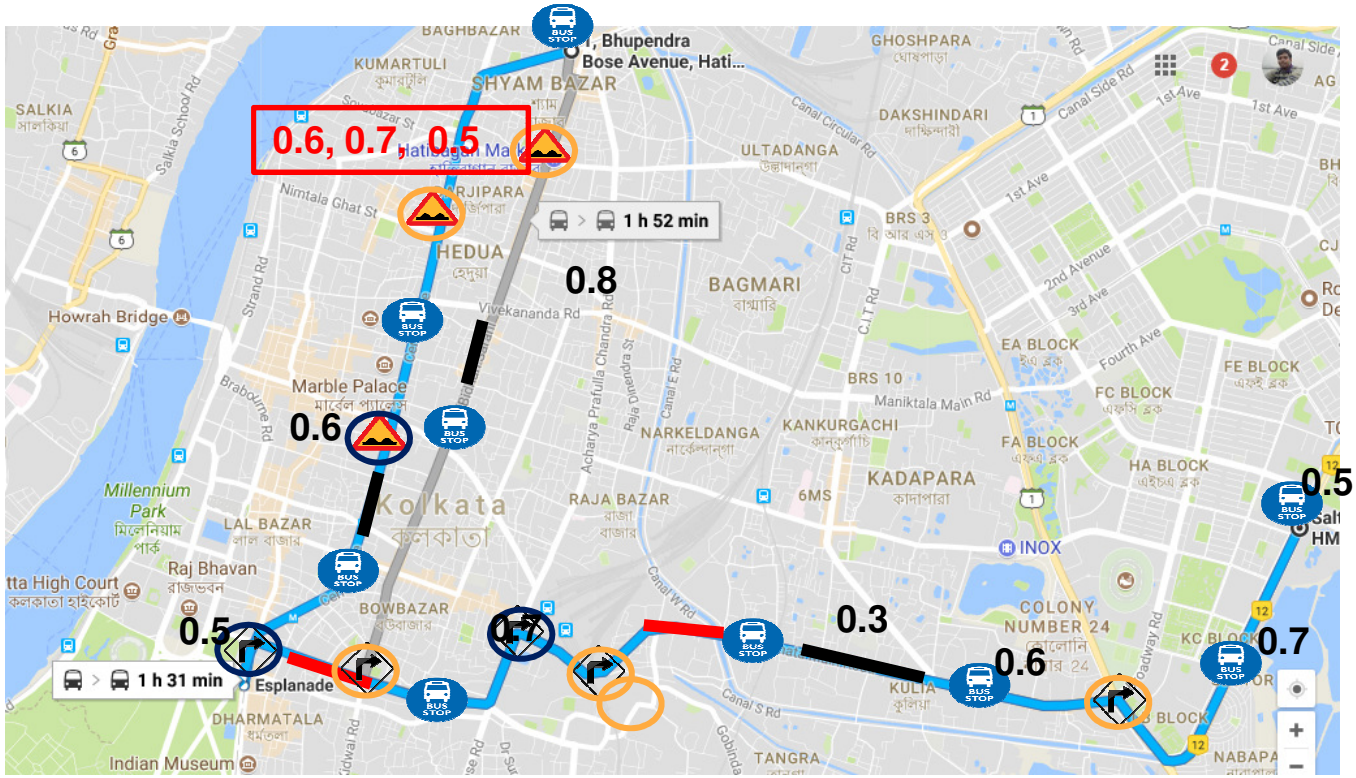
Annotated City Map

Probability of sitting



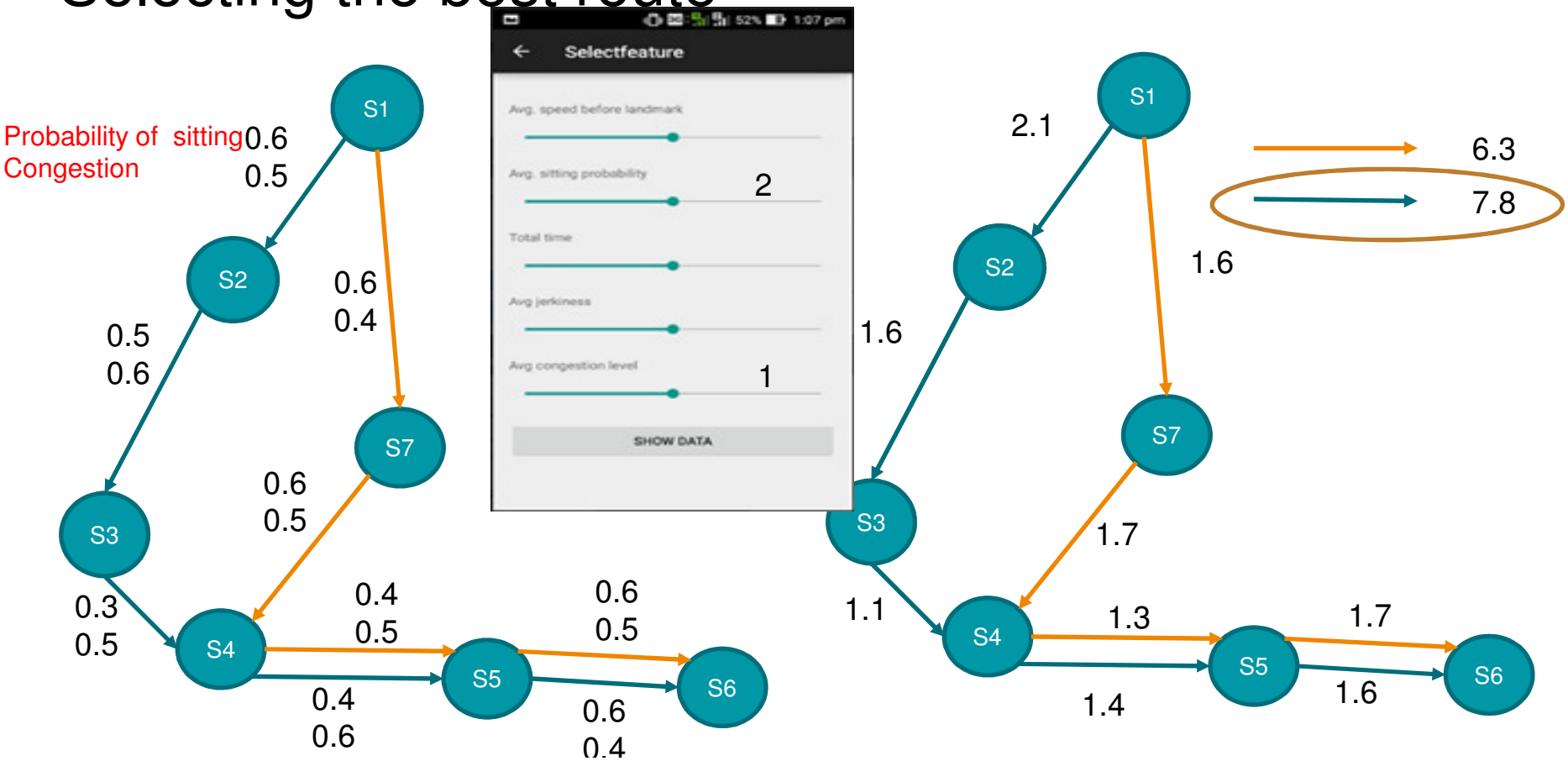
Annotated City Map

Probability of sitting, jerkiness, congestion

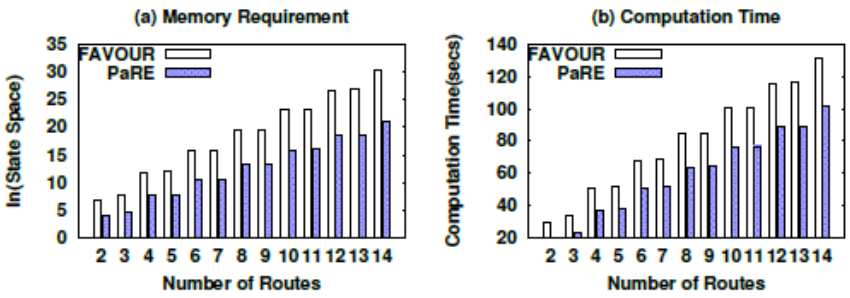


Selecting the best route

Selecting the best route

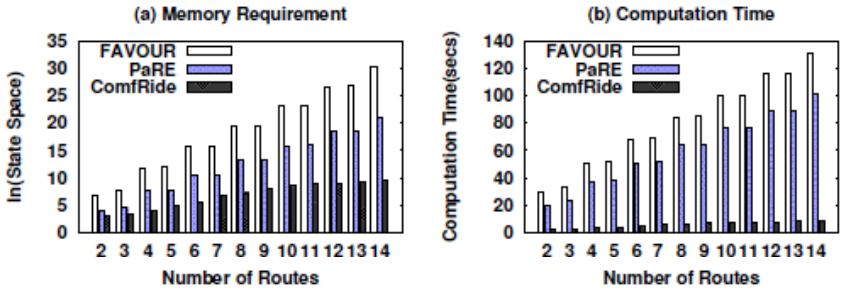


A Major Challenge



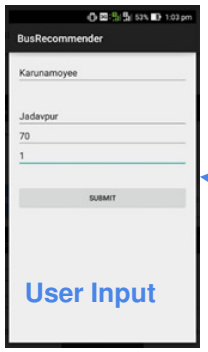
- Recommendation systems have very high memory requirement when we precompute or computation time when we **compute on the fly.**
- This is not permissible for mobile application

Solution: Using DIOA

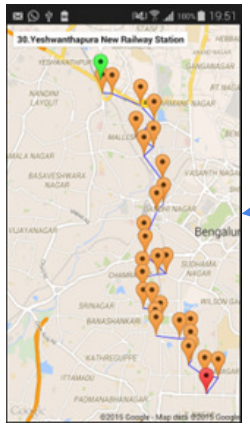


- Utilize **Dynamic Input Output Automata (DIOA)** which prunes and updates the graph dynamically based on the context of a query.
- DIOA has a set of *internal actions* which dynamically includes only those nodes and edges of the route graph which are required as per the query.

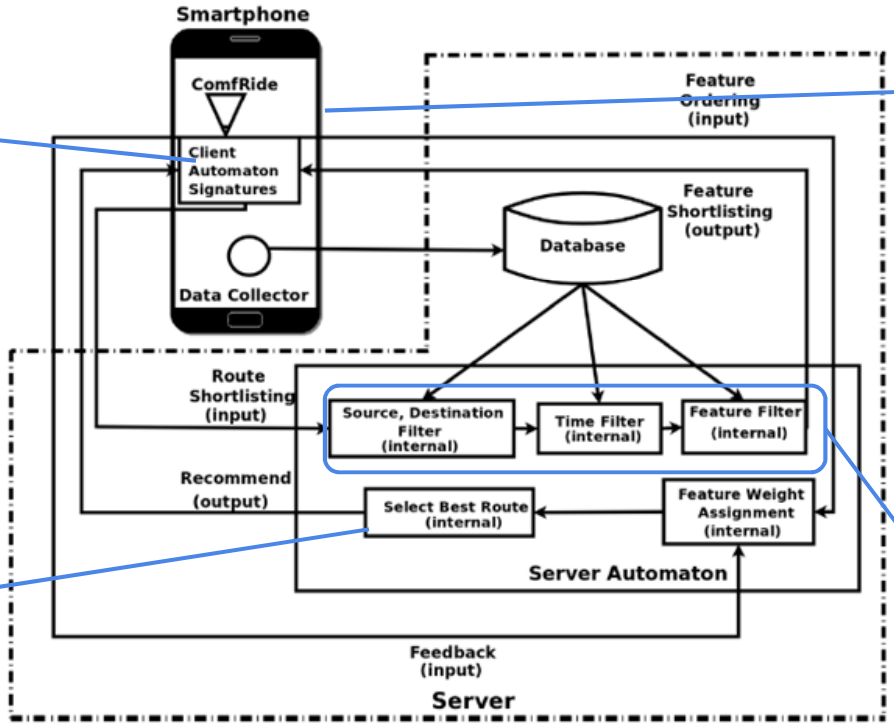
System Architecture

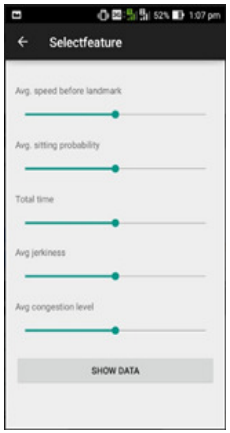


User Input



Recommended Route

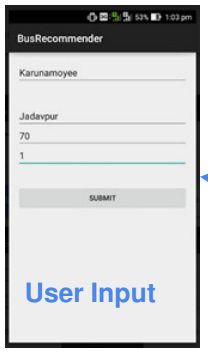




Feature Ordering

Optimized graph generation by pruning unwanted nodes

System Architecture



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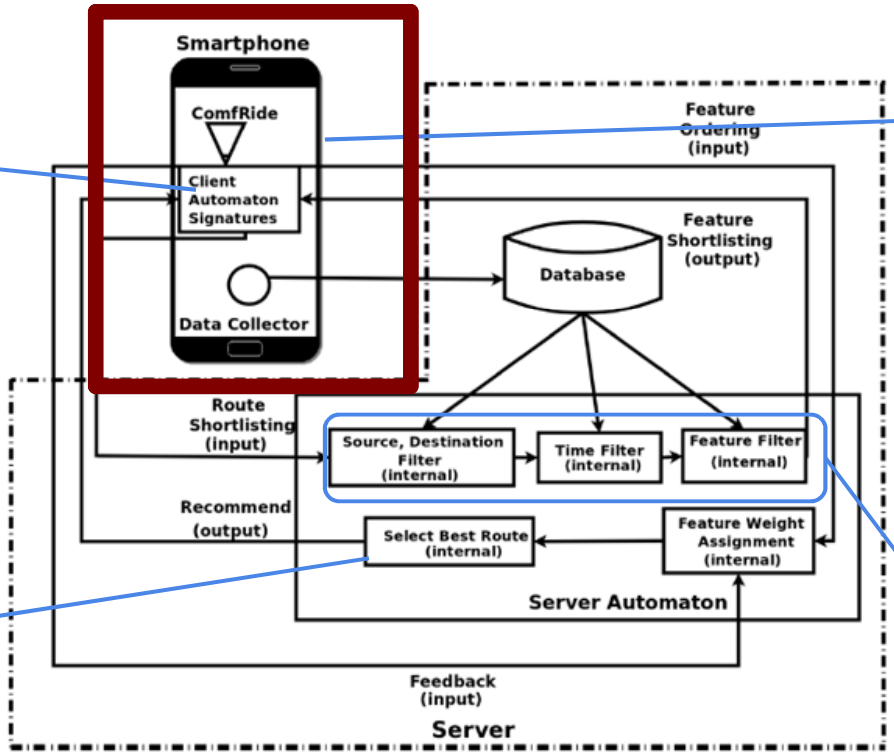

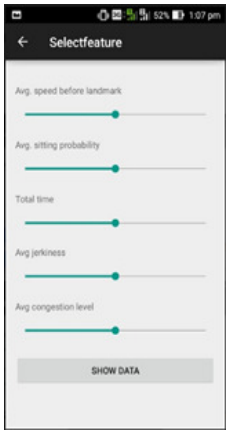

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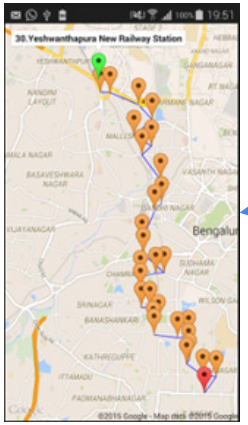
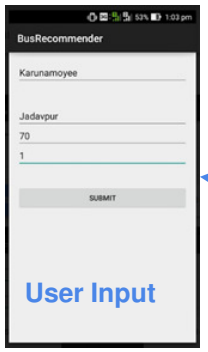


Recommended Route

System Architecture



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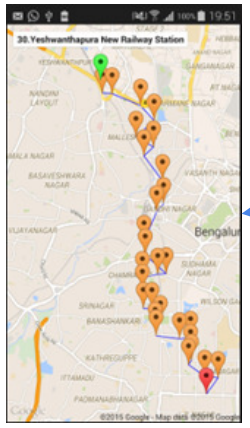
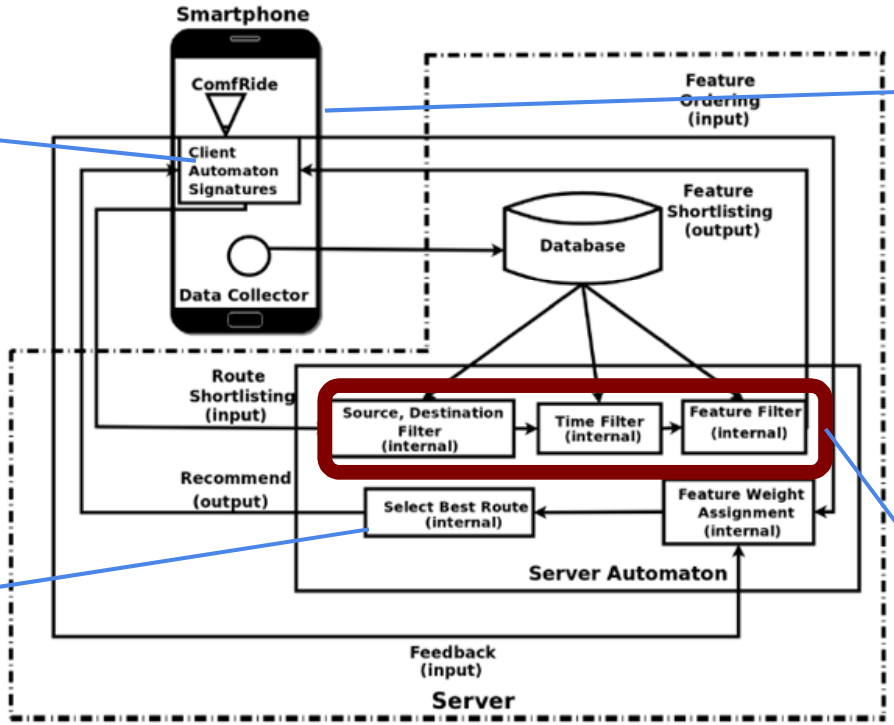
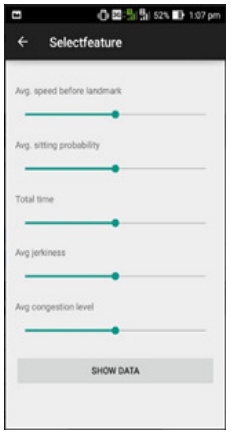


Recommended Route





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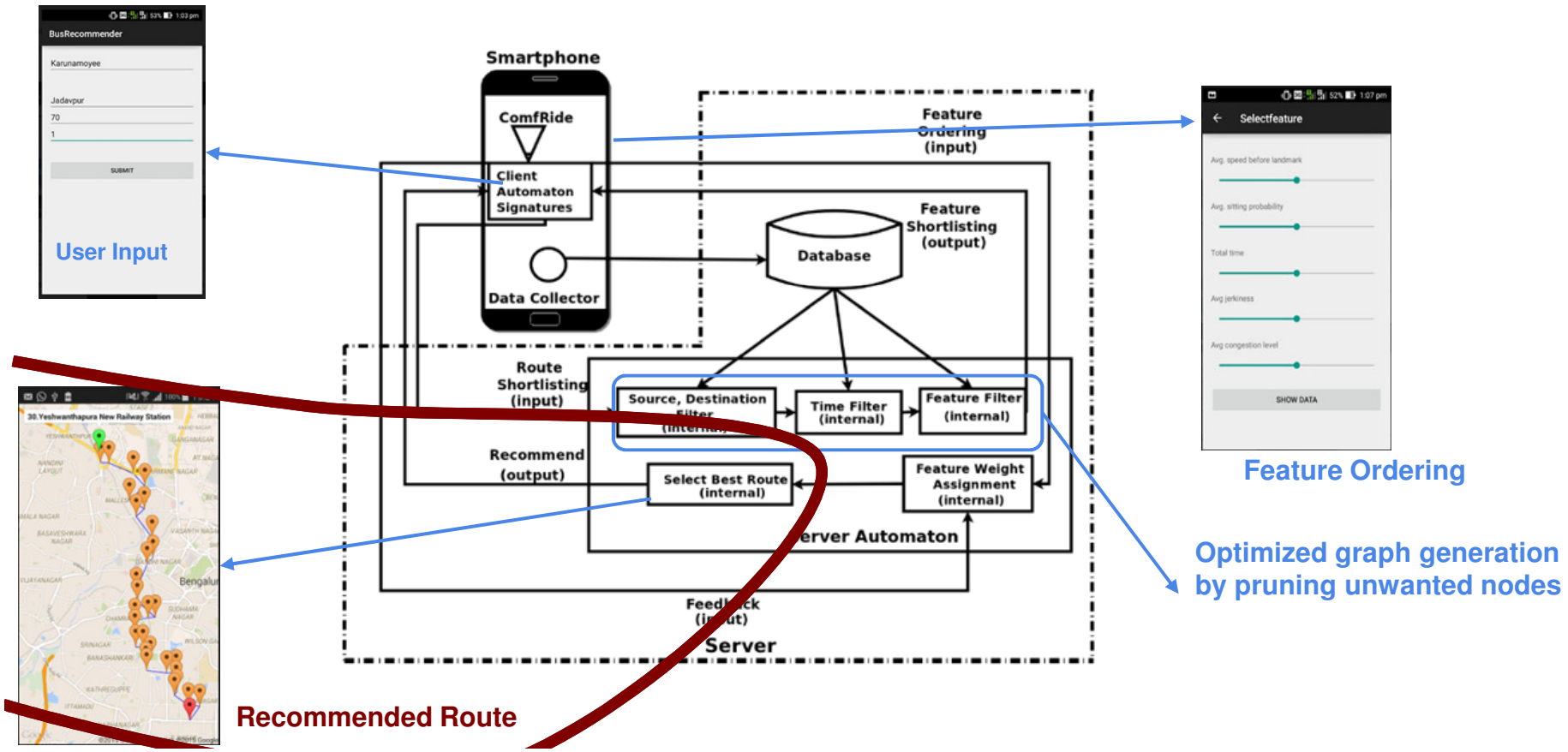
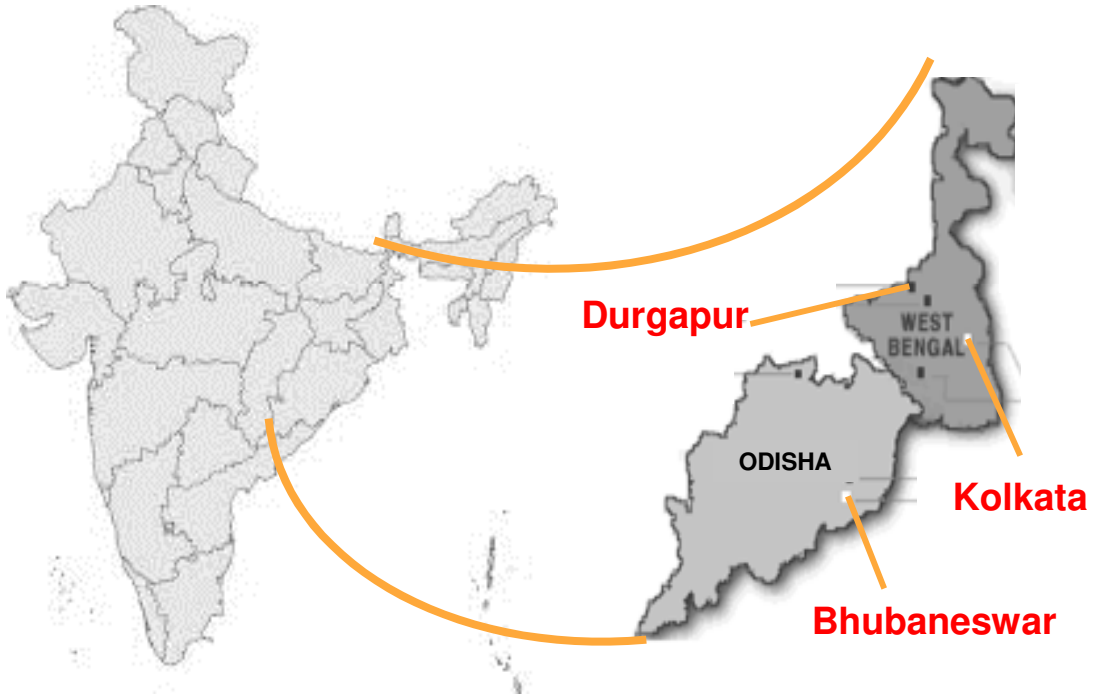


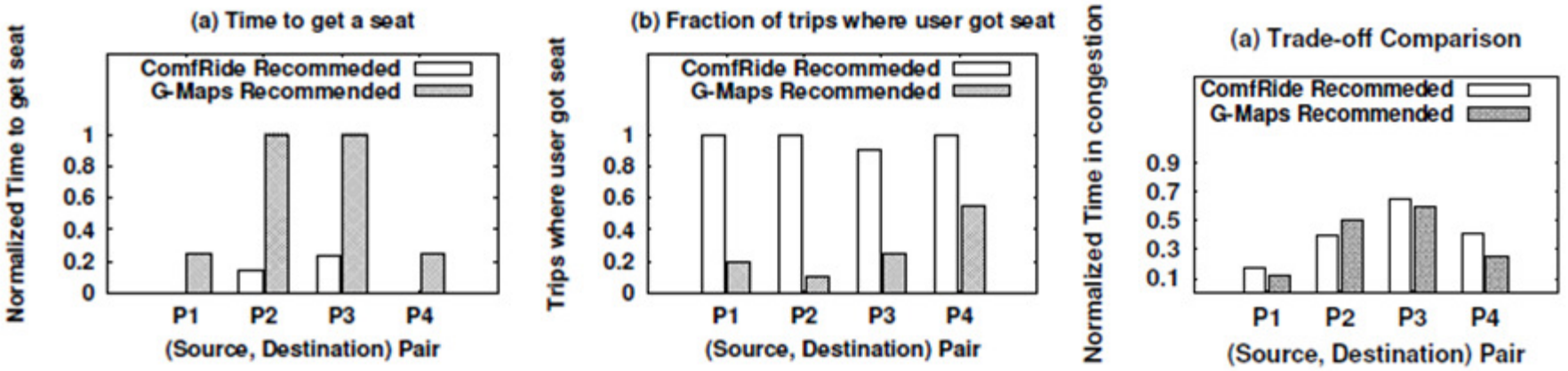
Experiment setup



- 50 volunteers were recruited for data collection across three cities, Kolkata, Bhubaneswar, Durgapur
- Some volunteers were given specific routes while others followed their regular routes
- Every trip was taken by a group of volunteers on different days at various time of the day.
- They travelled through both the ComfRide recommended route as well as the Google Maps (G-Maps) recommended route (least expected time).

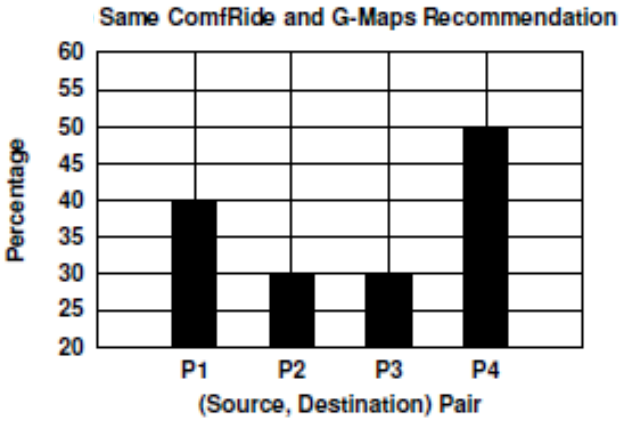
Evaluation - Deployed at Kolkata, 4 S-D Pairs

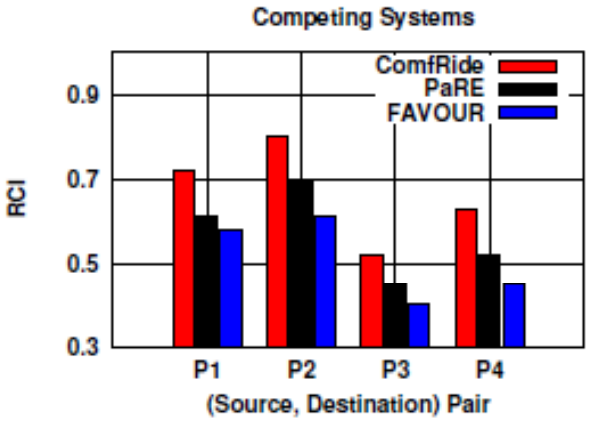
(S,D) Pair	Source	Destination	Distance (km)			Average Travel Time (min)		
			1	2	3	1	2	3
P1	KM	RH	10	10	15	55	55	65
P2	SC	RH	6	6	6	30	30	30
P3	SC	Gh	8	8	-	45	50	-
P4	KM	JP	15	15	-	70	65	-



Results when giving preference to sitting probability

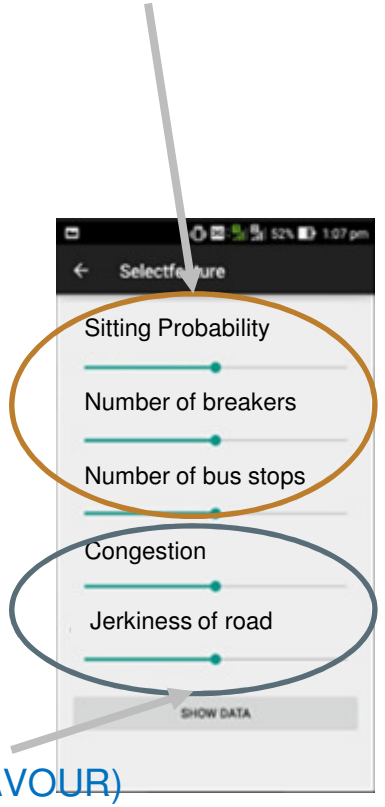
Evaluation: Contd..





- ComfRide recommended routes differ from G-Maps recommended routes for many instances, which is as high as 70% for P2 and P3
- FAVOUR (IEEE ITS 2017) gives **priority to the general choices of the commuters** over a route, and so, fails to capture the personal choices of a commuter
- PaRE (www 2017) gives **priority to the personal choices**, and thus ignores environmental impacts

Personalized Features (PaRe)



General Features (FAVOUR)

Conclusion

- The key concept behind ComfRide is to embed the **general awareness** and **intelligence** used by a regular commuter to choose the best (comfortable) bus route to reach her desired destination.
- ComfRide recommended routes have on average 30% better comfort level than Google navigation based recommended routes.
- Final Solution of better quality journey is NOT recommendation but have better roads and reliable, comfortable public transport.

Transport Researches at CNeRG

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Thank you!

ComfRide: http://rohit246.github.io/sites/comfride/

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