Utilizing Real-Time Travel Information, Mobile Applications and Wearable Devices for Smart Public Transportation

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Latest Trends

- Use of ICT and big data in public transportation
  - Demand forecasting [1][2]
  - Planning and operations management [3][4]
- Installing sensors on public transportation vehicles
  - Providing real-time approximate arrival times [5][6]
  - Disseminating information from over 20,000 stops

Motivation

- Enabling personal transportation management
- Aiding passengers' decisions
  - Saving time
  - Adapted to transportation disruption

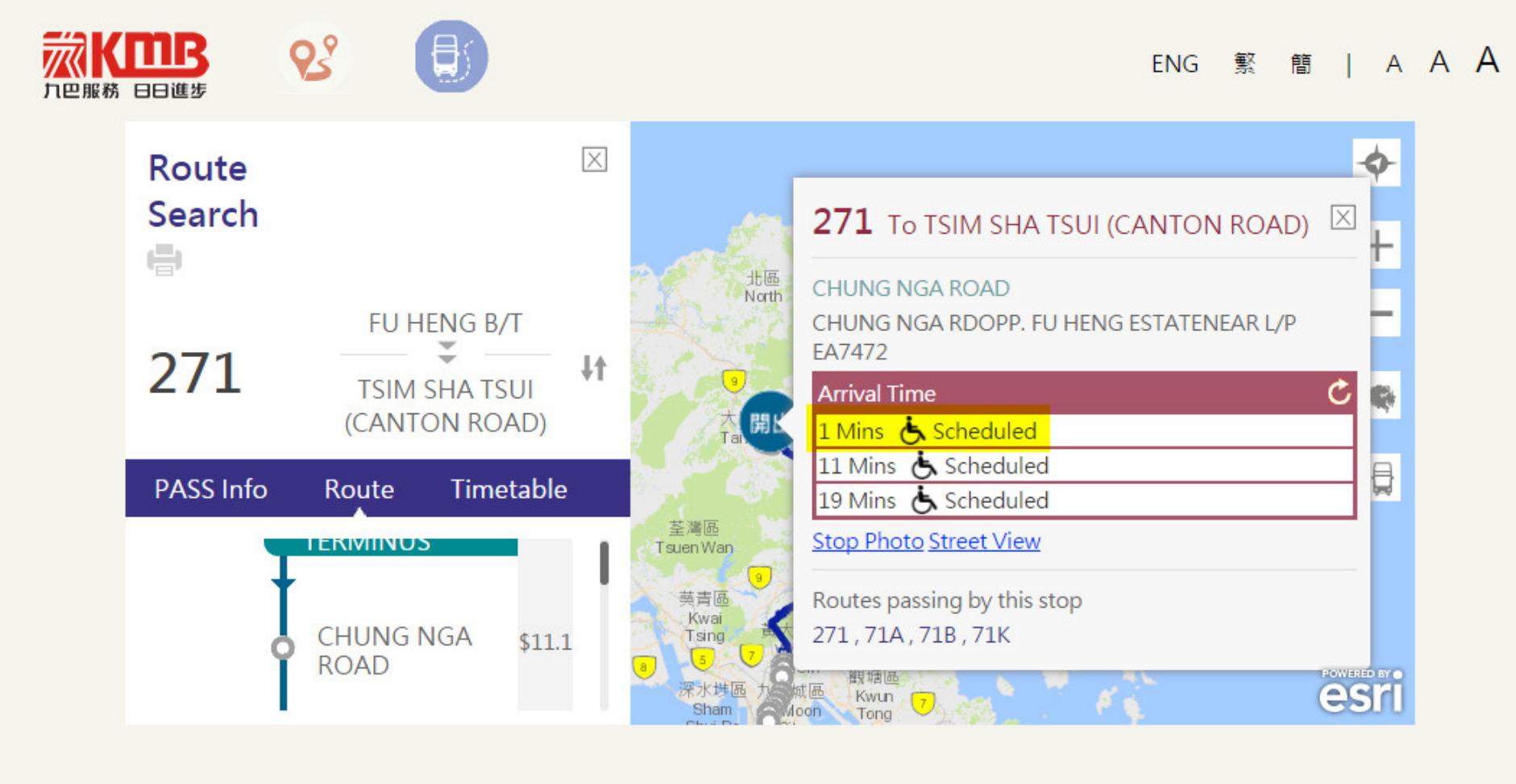
Motivation

- Existing public transport recommendation tools
  - Google Maps
  - Citymapper
- Not utilizing real-time traffic information
- Returning recommendations which are not personalized
- Lacking of real-time alternatives in dynamic situations
- Incorporating personalized life-style information when making recommendation?

Exemplary Implementation

- Kowloon Motor Bus (KMB)
  - Major bus service provider in New Territories and Kowloon
  - A daily average of 2.66 million passenger trips
  - Offering 377 routes
  - Started disseminating arrival time information in 2015

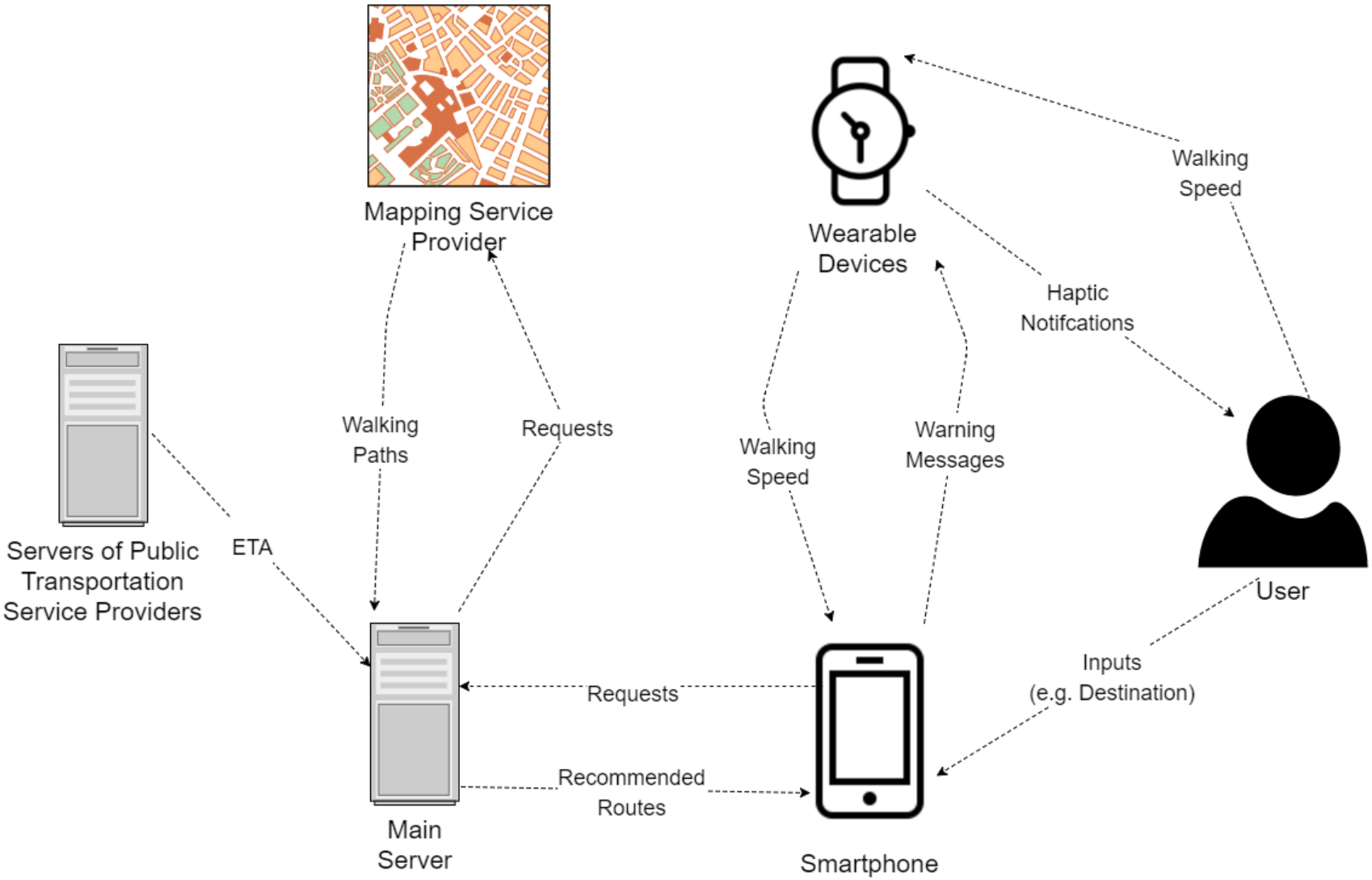
Exemplary Implementation



Exemplary Implementation

- Dynamic data: estimated time of arrival (ETA)
- Static data
  - Routes details
  - Stops information
- Facilitating identification of stops nearby and possible routes
- Updated from time to time

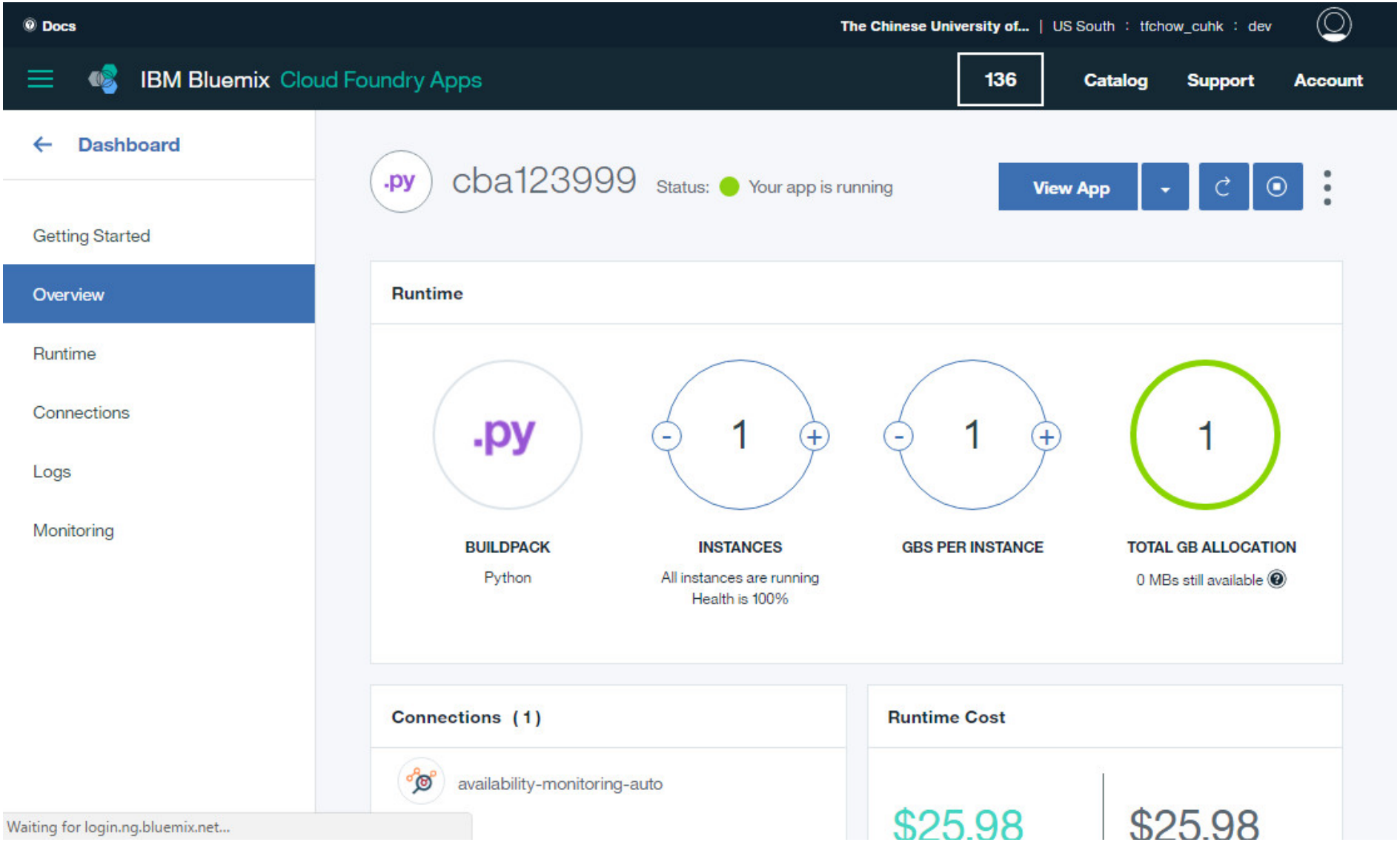
Big Data Cloud Platform



Cloud Infrastructure

- IBM Bluemix
  - Platform-as-a-Service (PaaS)
  - Used Python and Django in this study

Cloud Infrastructure



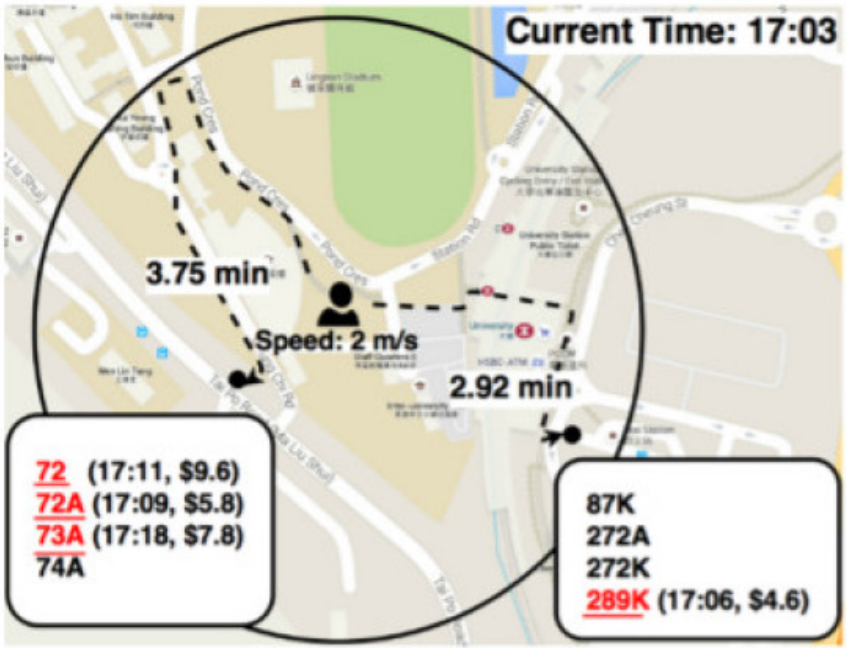
Wearable Devices

- Microsoft Band
  - Continually measuring user' walking speed
  - Sending vibrating and visual notifications
  - Displaying estimated arrival time

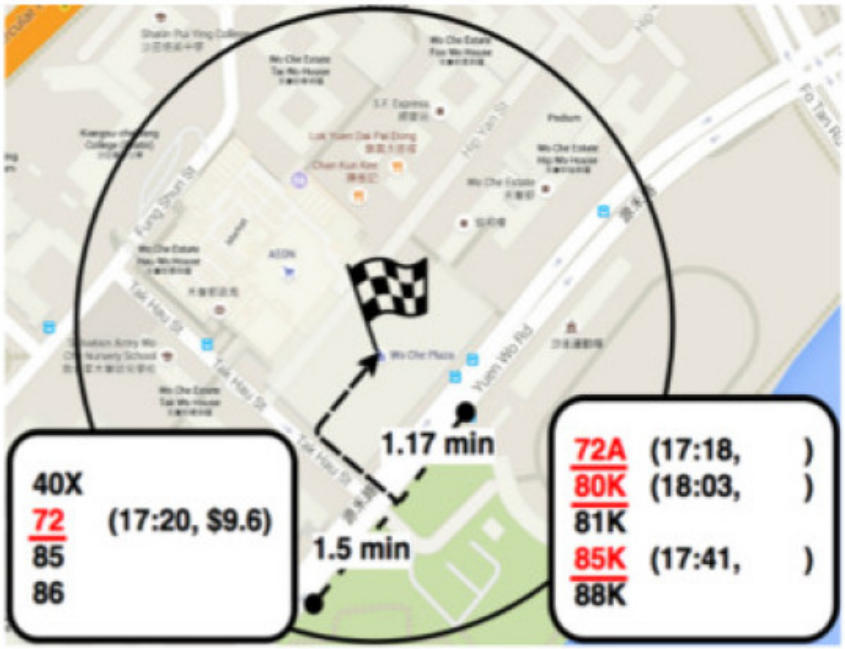
Wearable Devices

Wearable Devices

Example Scenario (CUHK → Shatin)

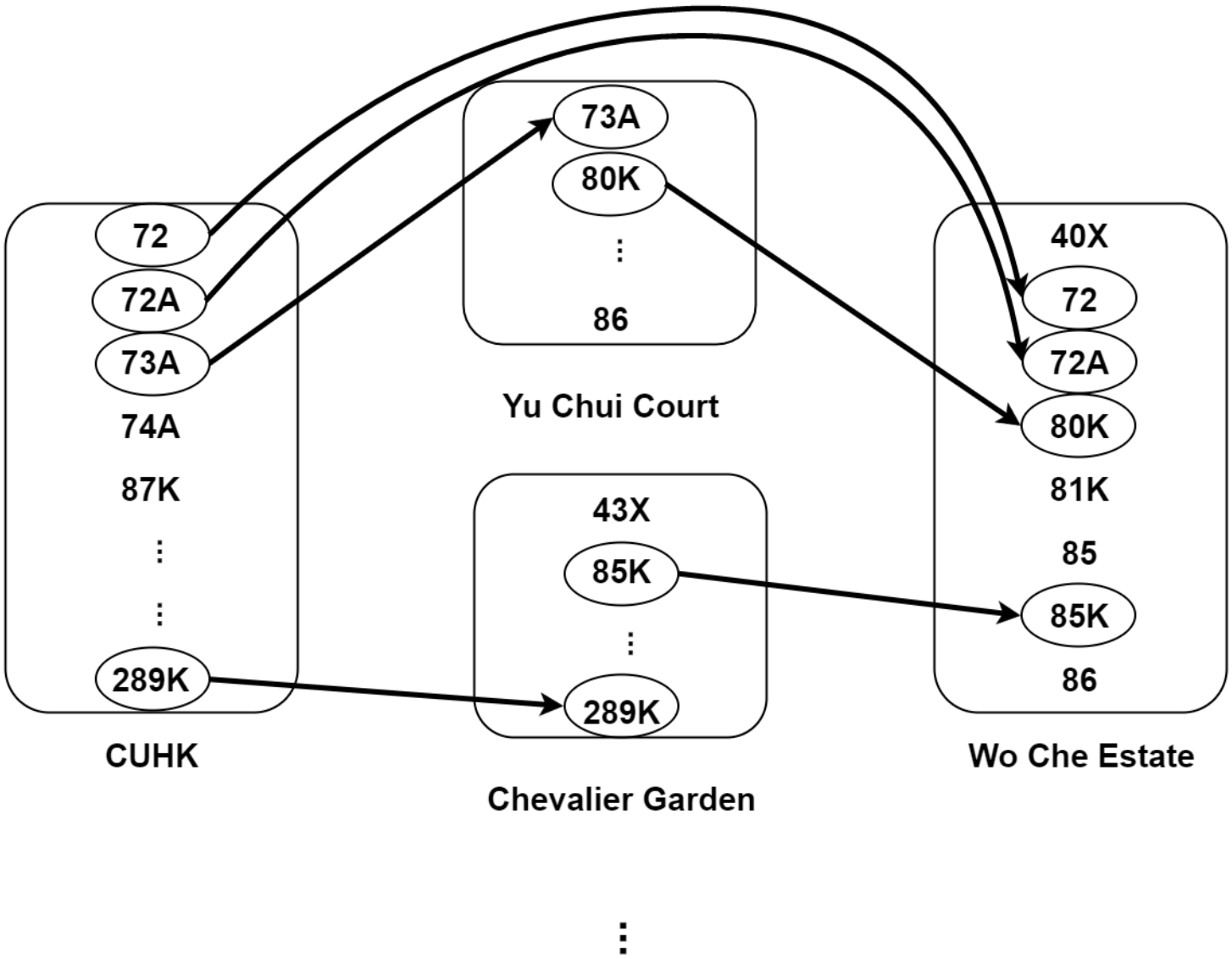


a. Current location (CUHK)



b. The destination (Wo Che)

Retrieving Possible Transit Routes



Path Choice Evaluation

- Choosing a path p to minimize the goodness measure $g_p = \alpha_1 T_p + \alpha_2 W_p + \alpha_3 N_p + \alpha_4 C_p$
  - Total journey time (T_p)
  - Total walking distance (W_p)
  - Number of transfers required (N_p)
  - Total travelling cost (C_p)
- Weights $(\alpha_1, \alpha_2, \alpha_3, \alpha_4)$: determined manually

Choice Evaluation

- Example weights: $(\alpha_1, \alpha_2, \alpha_3, \alpha_4) = (10, 20, 1, 100)$
- Best choice: Route 72A

Option	Estimated total journey time (min)	Cost ($)	Total walking distance (m)	No. of bus transfer	g_p
Route 72	18.5	9.6	630	0	1007
Route 72A	**16.17**	**5.8**	**630**	**0**	**907.7**
Route 73A & 80K	61.17	12.9	630	1	1599.7
Route 289K & 85K	39.17	9.7	630	1	1215.7

Novel Features

- Helping users to manage personalized transportation
- Minimizing total waiting time
  - Using wearable devices to capture walking speed
  - Computing likelihood by GPS and ETA
  - Alerting users

Conclusion

- Facilitating personal transportation management by big data
- Utilizing real-time information with smartphones and wearable devices
- Optimizing users' travelling plan
- Expected to be utilized in other cities heavily relying on public transportation

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Thank You!