

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

The screenshot displays the KMB mobile application interface. At the top left is the KMB logo with the tagline "九巴服務 日日進步". To the right are icons for location and bus, and the text "ENG 繁 簡 | A A A".

The main interface is divided into two panels. The left panel, titled "Route Search", shows the selected route "271" with a dropdown menu for "FU HENG B/T" and a destination "TSIM SHA TSUI (CANTON ROAD)". Below this are tabs for "PASS Info", "Route", and "Timetable". A vertical line indicates the current stop "CHUNG NGA ROAD" with a fare of "\$11.1".

The right panel shows a detailed view of the "271 To TSIM SHA TSUI (CANTON ROAD)" route. It lists the stop "CHUNG NGA ROAD" with address "CHUNG NGA RDOPP, FU HENG ESTATE NEAR L/P EA7472". A table shows arrival times for three different services:

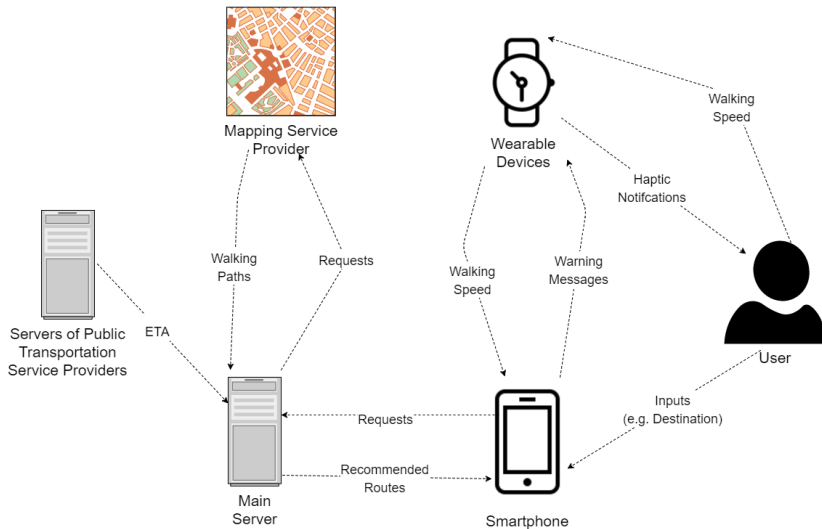
Arrival Time	
1 Mins	♿ Scheduled
11 Mins	♿ Scheduled
19 Mins	♿ Scheduled

Below the table are links for "Stop Photo Street View" and "Routes passing by this stop" (271, 71A, 71B, 71K). The map in the background shows the current location on a street grid. The bottom right corner features the "POWERED BY esri" logo.

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

Docs The Chinese University of... | US South : tfchow_cuhk : dev

IBM Bluemix Cloud Foundry Apps 136 [Catalog](#) [Support](#) [Account](#)

← Dashboard

Getting Started

Overview

Runtime

Connections

Logs

Monitoring

cba123999 Status: ● Your app is running [View App](#)

Runtime

BUILDPACK Python	INSTANCES All instances are running Health is 100%	GBS PER INSTANCE	TOTAL GB ALLOCATION 0 MBs still available

Connections (1)

availability-monitoring-auto

Runtime Cost

\$25.98	\$25.98
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Waiting for login.ng.bluemix.net...

Wearable Devices

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

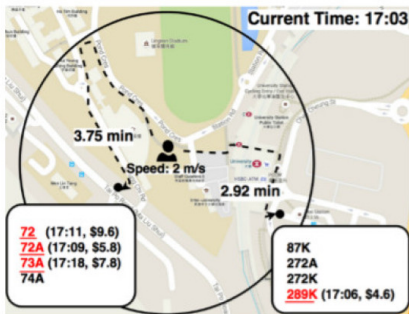
Wearable Devices



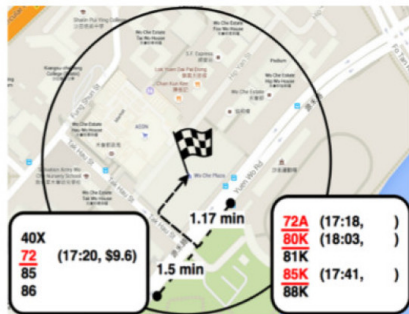
Wearable Devices



Example Scenario (CUHK → Shatin)

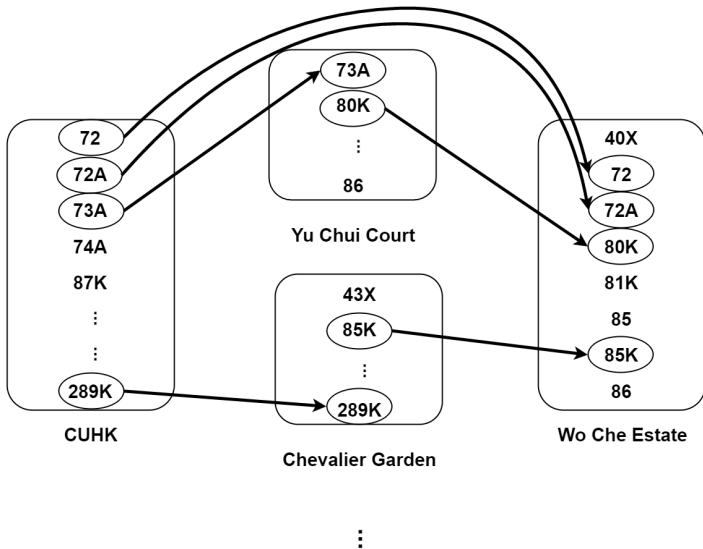


a. Current location (CUHK)



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!