Using Smartphones for Dynamic Mapping and Planning of Transit Systems in Africa

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Smartphones and Locational Data

The result: we can collect locational data, easily, anywhere in the world.
Trotros in Accra - Background

Accra: Capital City of Ghana
Trotros in Accra - Background

• Accra Municipal Assembly
  – Registers routes, drivers and vehicles
  – Sets harmonized fares

• Operator Unions
  – Operate out of dedicated terminals
  – Deliver transport services (Trotros)
  – Negotiate fares
Accra Mobile Project - Background

• Accra Municipal Assembly had:
  – List of routes
  – Origin and destination terminus
  – Regulated fare

• ...but lacked information on...
  – Routes in service
  – Actual route (itinerary)
  – Stops
  – Actual fares
AccraMobile Objectives – Phase I

1. Audit existing routes

2. Map existing route itineraries

3. Collect stop data
DataMobile Travel Survey App

DataMobile on Android

DataMobile on iPhone
## Short Survey

**Travel to Work**

**HOW DO YOU TYPICALLY COMMUTE TO YOUR WORK LOCATION?**

- Public Transit
- Bicycle
- Car (as driver)
- Car (as passenger)
- Walk only
- Car and public transit

**DO YOU USE ANY ALTERNATIVE MODE OF TRAVEL TO WORK?**

No
Data Collection and Visualization
Tap Log

• A personal event logger
• Logs events and associated information
• ...including locational data
Use of Apps

1. DataMobile used to collect
   • Route itineraries
   • Distances and travel times

2. TapLog used to collect
   • Stop location and name
   • Boardings and alightings
   • Fares
Project Conception

AMA – Dept. Of Transport
Project definition: mapping Accra’s Trotros
Feedback on practical issues arising from field-testing

AFD
Facilitation

Concordia University
Draft data-collection protocol using GPS-enabled smartphones
Adjustments to protocol

TWO MONTHS
Data Collection

AMA – Dept. Of Transport
- Data collection: dispatching of eleven surveyors on the field
- Visual verification of collected data
- Correction/additional recording

AFD
- Facilitation

Concordia University
- Automated processing and quality check
- Route mapping
Data Processing and Preparation

AMA – Dept. Of Transport
Data collection: dispatching of eleven surveyors on the field
Visual verification of collected data
Correction/additional recording

AFD
Facilitation

Concordia University
Automated processing and quality check
Route mapping

TRIP Lab Servers
Final Route Mapping

AMA – Dept. Of Transport
Data collection: dispatching of eleven surveyors on the field
Visual verification of collected data
Correction/additional recording

AFD
Facilitation

Concordia University
Automated processing and quality check
Route mapping

TWO MONTHS
Correction/Validation

AMA – Dept. Of Transport
Data collection: dispatching of eleven surveyors on the field
Visual verification of collected data
Correction/additional recording

AFD
Facilitation

Concordia University
Automated processing and quality check
Route mapping
Findings – route Audit

• Of 580 routes registered...
• ...only 315 in service and mapped
• Unmapped routes were:
  – Inexistent (reporting errors)
  – Inactive ("ghost routes")
Map of Routes
Map of Routes
Map of Routes

Allowed identification of underserved areas.
Concentration of stops:

- Around terminals
- Along main roads
### Findings – Route Characteristics

<table>
<thead>
<tr>
<th>N=629</th>
<th>Speed</th>
<th>Fare</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Km/h</td>
<td>In/out Diff</td>
</tr>
<tr>
<td>Minimum</td>
<td>4.17</td>
<td>0.01</td>
</tr>
<tr>
<td>Maximum</td>
<td>59.24</td>
<td>41.74</td>
</tr>
<tr>
<td>Mean</td>
<td>16.07</td>
<td>4.72</td>
</tr>
<tr>
<td>Median</td>
<td>14.59</td>
<td>3.62</td>
</tr>
</tbody>
</table>
AccraMobile Objectives – Phase II

• Make Trotro route data more accessible
  – GTFS
  – User-friendly map
• In-depth knowledge of routes and operations
  – Route itinerary variation
  – Estimates of total transit supply
GTFS

- General Transit Feed Specification
- Database standard describing a transit system
- Allows for routing with Google Transit and apps
- AMA wanted Accra data in this format
GTFS - Hackathon

- 40 participants, 15 teams
- 1st Prize - Mogo
  - Multimodal trip planning smartphone app
- Most innovative – Magic Route
  - SMS trip planner
- Runner-up – Wool3 (Woolé)
  - Social media journey planner
GTFS -> User Map
GTFS -> User Map

- Useful to planners and authorities
- Difficult for Trotro users to interpret
GTFS -> User Map

- With GTFS data...
- ...Postgres/PostGIS
- ...QGIS...
- ...a Fine Arts student...
- and Illustrator...
Route Variation

• Phase I provided a snapshot of Trotro system
• A critical question for users:
  – Do routes always take the same roads?
  – Do they always take the same amount of time?
• One goal of Phase II was to understand how much variation
Route Variation

Routes operating from Kaneshie Station
Total Transit Supply

• Trotro map indicates extent of the system
• Route variation provides estimate of reliability
• Total transit supply is unknown
• Phase II will allow estimates of total supply
Total Transit Supply

- The system is organized around terminals
- Terminals are divided into substations
Total Transit Supply

• A substation houses:
  – ~6 routes
  – ~50 Trotros

• Trotros allocated to routes on boards

• Record of boards provides all activity

• This info + maps can lead to supply estimates

Example of route assignment board
Conclusions

• AccraMobile continues to demonstrate:
  – Successful use of collaborative technologies for teams working far apart on dynamic mapping
  – Technological leapfrogging of planning techniques in Africa
  – Interest of using mobile technologies for transit planning in Accra
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