Mobile Advertising: Triple-win for Consumers, Advertisers, and Telecom Carriers (A positional paper)

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From Consumers' Perspective

- The lower VAS prices and internet accessing charges the customers get, the more customers we find.

- One way to lower mobile internet charges is to obtain sponsor from mobile advertising, i.e. watching ads in exchange

- Mobile advertising is an important way of web monetization strategies, especially for telecommunication corporations.

From Advertisers' Perspective

- ## The growing popularity of mobile device
 - mobile cellular subscriptions have reached over 70% of the world population at the end of 2010.

  - High Penetration Rate, Personal Communication Device and Interactive

From Telecoms' Perspective

- Mobile broadband subscriptions are less than 20 percents of the mobile subscriptions. [Mobile Tech News]
  - The high payments
  - VAS (Value-Added Services) is deeply influenced.
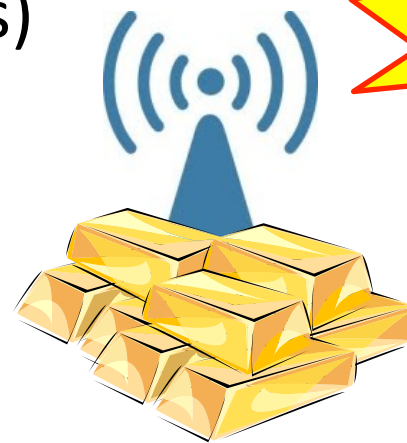
Idea

- Triple-win
  - Telecommunication providers run the ads agent platform to attract investments from advertisers.
  - Subscribers read promotional ads that are sent to subscribers' mobile phones to get discount payment of mobile Internet accessing from telecommunication.
  - The advertisers register promotional ads, they pay a reasonable price to telecommunication.

(Telecommunication)

Register & Payment

Subscription Ads Allocation

(Advertiser)

Commercial Behavior
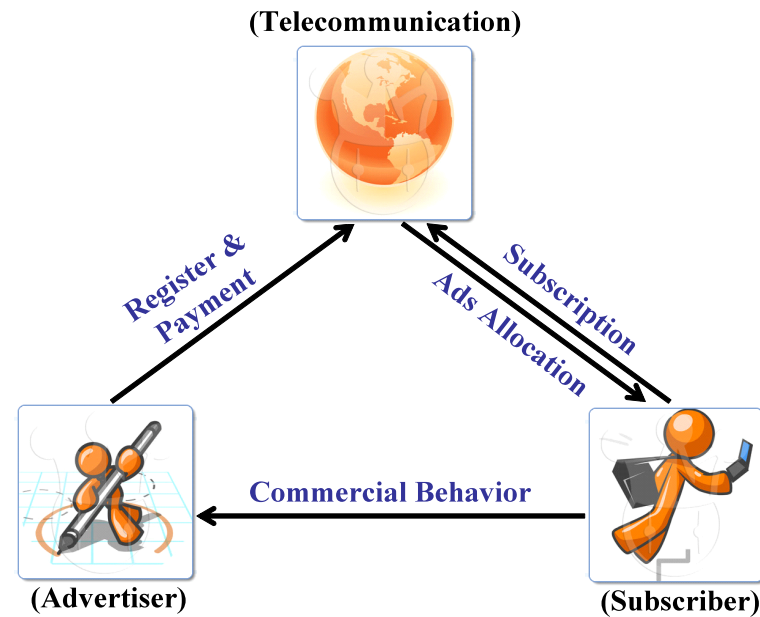
(Subscriber)

Three Key Issues

- Sending the appropriate mobile ads to the most potential subscriber at the best time in the right place is the key issue!

  - How to show ads in subscriber's mobile device?

  - When to show the ads?

  - What potential ads will be clicked by the user?

Related Work

- Consumer Behavior and Personalized Advertising

- Web Contextal Advertising

- Mobile Advertising

Consumer Behavior and Personal Advertising

- Turban et al. [ICEC2000] described the main influences on the consumer's decision:
  - consumer's individual characteristics, the environment and the merchant's marketing strategy components (e.g., price and promotion)

- Varshney & Vetter [Mobile Networks and Applications 2002] proposed mobile advertising and shopping application could include
  - Demographics, location information, user preference, and store sales and specials

Consumer Behavior and Personal Advertisng (cont.)

- Rao's & Minakakis [COMMUNICATIONS OF THE ACM 2003] proposed the marketing technique base on
  - Knowledge: customer profiles, history, and needs
  - Advertising activities: location, time and time-related item such as local events
- Xu et al. [Decision Support Systems 2008] proposed a user model based on
  - Context: user activities, user location, weather, and time
  - User preference: cuisines, food, type, restaurant service and restaurant ambience
  - Content: price, discount, brand

Web Contextal Advertising

- Several studies pertaining to advertising research show that
  - The more targeted the advertising, the more effective it is. [Novak, World Wide Web Journal 1997].
- Contextual advertising
  - Assignment of relevant ads within the content of a generic web page
  - Matching pages to ads based on extracted keywords [Ribeiro-Neto et al., SIGIR'05]

Mobile Advertising

- Existing methods: SMS, Applet, Browser
  - SMS: free to receive SMS
  - Applet & Browser: broadband access

- SMS: the most common method
  - Infrastructure limitation make this method difficult to scale to personalized advertising
  - Giuffrida et al. [EDBT'07], Penev et al. [CIKM'09]

Mobile Advertising (cont.)

- Applet Marketing
  - Google acquired AdMob (Nov. 2009)
    - Mobile advertising platform
  - Apple iAd (Apr. 2010):
    - Share benefit between third-party developers
  - Another kind of triple win among 1) consumers, 2) advertisers and 3) developers

- Browser
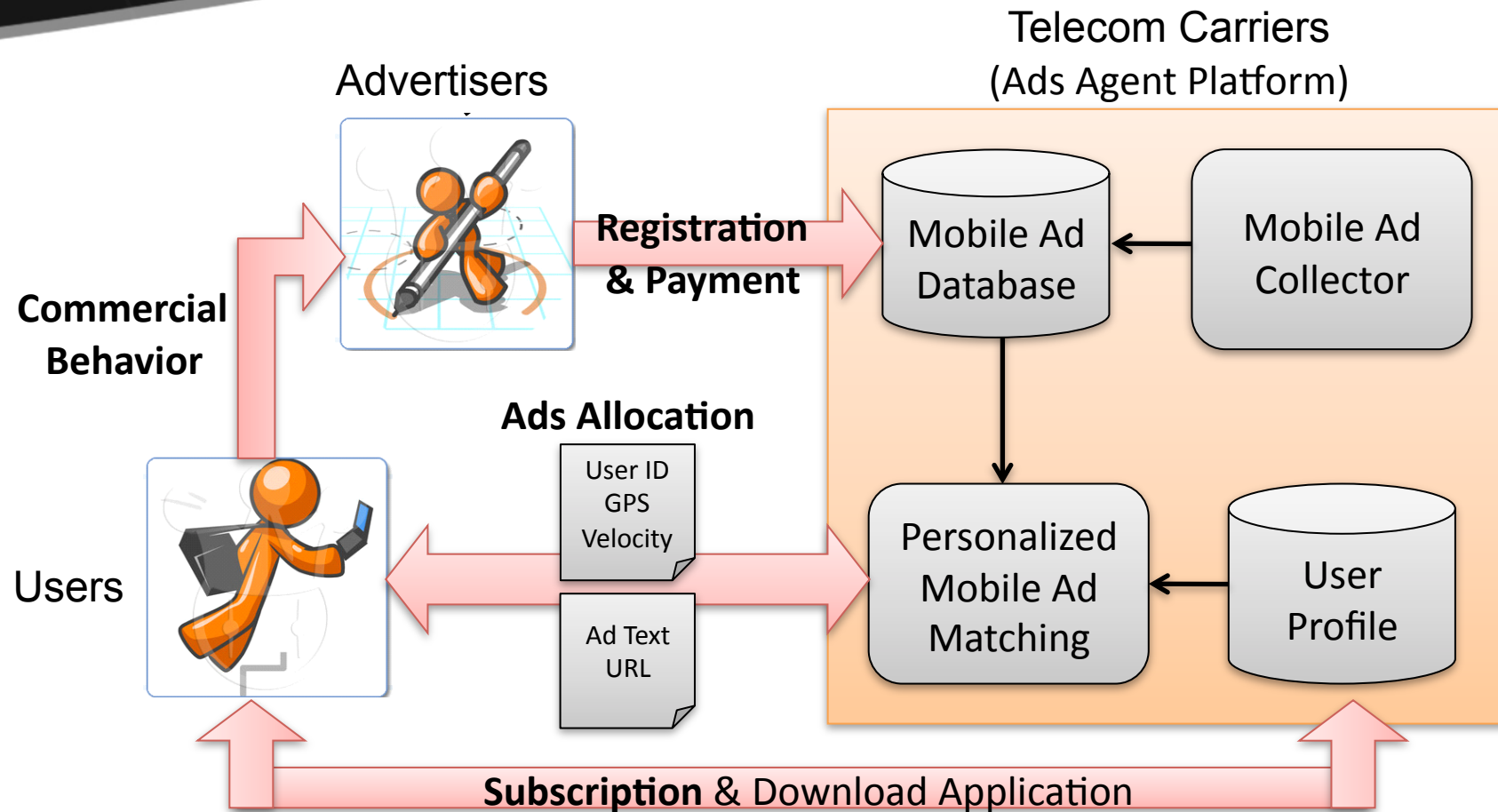 - Web contextual advertising

Design Methodology

- System architecture

- Address the 3 key issue for mobile advertising

- Personalized ad matching

System architecture

Telecom Carriers
(Ads Agent Platform)

Advertisers

Registration & Payment

Mobile Ad Database

Mobile Ad Collector

Commercial Behavior

Ads Allocation

User ID
GPS
Velocity

Ad Text
URL

Users

Personalized Mobile Ad Matching

User Profile

Subscription & Download Application

Addressing the 3 Key Issues
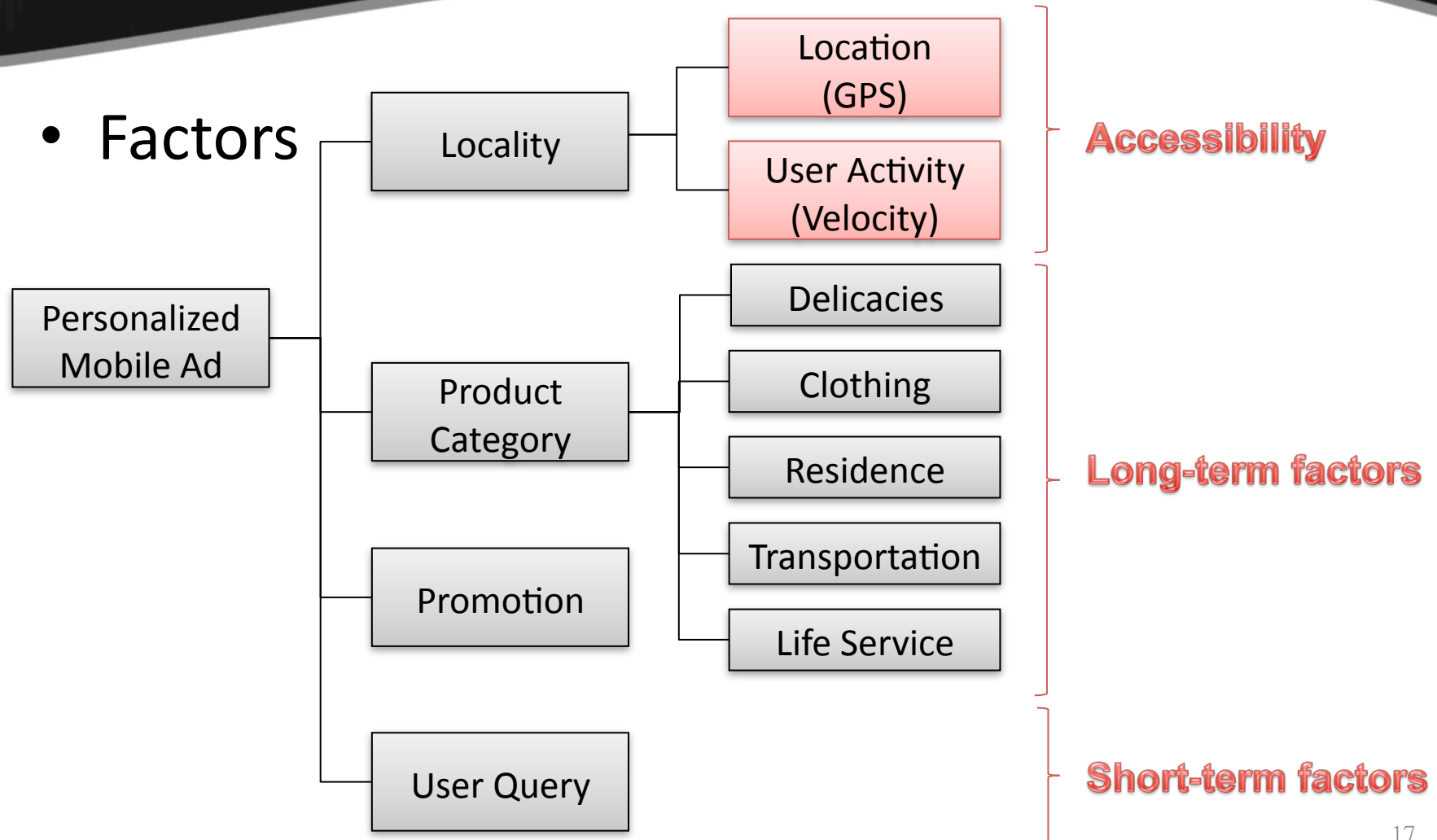
- Sending the appropriate mobile ads to the most potential subscriber at the best time in the right place is the key issue!

    – How to show ads in subscriber's mobile device?
    - – a particular applet to display ads and provide ad clicking info

    – When to show the ads?
    - – trigger-based and fixed schedule

    – What potential ads will be clicked by the user?

Measuring the time spent on Ads

- The mobile ad allocator provides the following information to the telecom Carriers (for charging of the network usage):
  - The number of mobile ads that are shown in the user device
  - The number of mobile ads that are clicked by the user
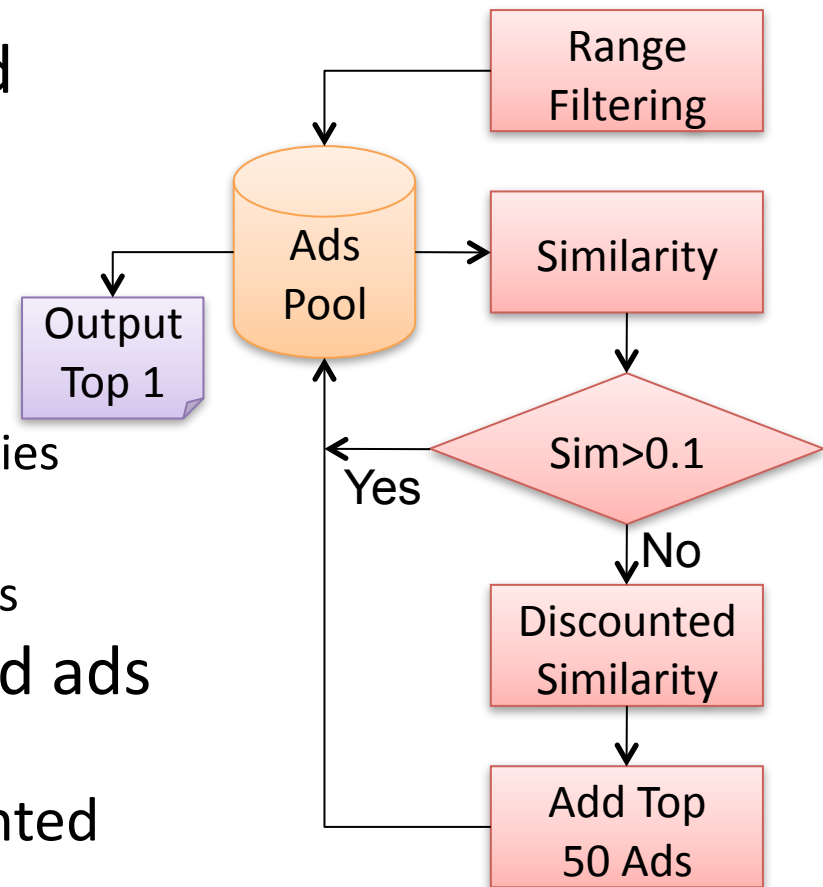 - Recording the time user spent on ads

What potential ads to be shown?

- Factors

Personalized Mobile Ad

- Locality
  - Location (GPS)
  - User Activity (Velocity)

  Accessibility

- Product Category
  - Delicacies
  - Clothing
  - Residence
  - Transportation
  - Life Service

  Long-term factors

- Promotion

- User Query

  Short-term factors

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Personalized ad matching

1. Ads filtering is based on GPS and Velocity
    -   Radius = v * m
2. Content similarity scoring
    -   Long-term factors
        -   Jaccard(J): Promotion and 5 categories
    -   Short-term factors
        -   User Query: Titles and landing pages
3. If the highest score of the filtered ads in step 1 is less than α, then
    -   add top ranked 50 ads by discounted score based on distance

Range Filtering

Ads Pool

Output Top 1

Similarity

Sim>0.1

Yes

No

Discounted Similarity

Add Top 50 Ads

Personalized ad matching (cont.)

- ## Similarity computation

$$Sim_{score}(u,a) = \alpha \times Jaccard(S_u, S_a) + Cos(q(u), t(a)) + Cos(q(u), p(a))$$

Where α ∈ [0.1,0.2]

- Long-term factors

$$Jaccard(S_u, S_a) = \frac{S_u \cap S_a}{S_u \cup S_a}$$

, where S_u and S_a are six dimension binary vector for the user and the ad respectively.

- Short- term factors

$$Cos(v_1, v_2) = v_1 \bullet v_2$$

- $q(u)$: user query
- $t(a)$: title of ads
- $p(a)$: landing page of ads

Personalized ad matching (cont.)

- Discounted score
  - For ads with distance < average distance
    - $$Sim_{discounted}(u,a) = 0.5 \times Sim_{score}(u,a)$$
  - For ads with distance > average distance
    - $$Sim_{discounted}(u,a) = 0.3 \times Sim_{score}(u,a)$$

Simulation Platform

- Mobile Ad Collector

- Simulation Platform

- Performance Evaluation

Mobile Ad Collector

- ## No real business environment
  - Due to the lack of considerable amount of mobile ads, we propose a mobile ad collector.

- ## The process of mobile ad collector:
  - Ad-crawler Platform
    - Collect online ads automatically form Google AdSense
  - Ad Feature Extraction
    - extract the following information from ads landing pages
      - Postal Address, Promotion Activity and Product Category

Mobile Ad Collector (cont.)
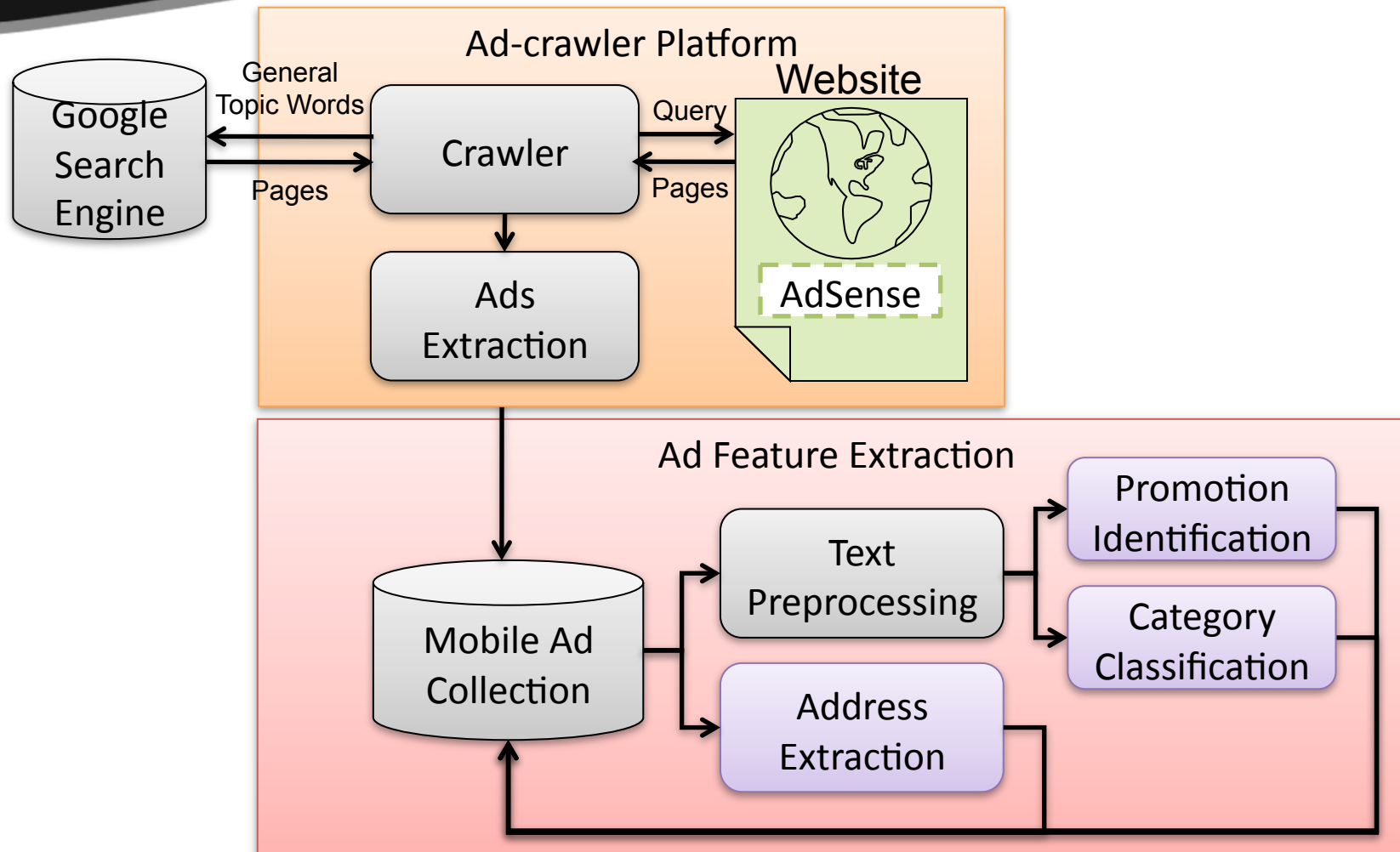
Ad-crawler Platform

- Topic words as query terms are requested web pages from search engines.

- About 200,000 URL were retrieved.

- Extract the corresponding web ads assigned by Google AdSense

- After removing repeated web ads,

  54,709 different web ads were collected.

  - Hyperlink, title and abstract

Ad Feature Extraction

- Postal address extraction

- Promotion activity identification

- Product category classification

Postal Address Extraction

- However, most of web ads contain no postal address.

    - Only 4,003 web ads contain postal address.

    - A total of 9,327 postal address are extracted.

- Hence, a geographic coordinate are assigned for each web ad randomly.

- Convert geographic coordinates into a postal address via Google Map API

Promotion Identification

- Train a classification to identify whether an ads contains promotion information.

- Training tuples:
  - 548 web ads with real postal addresses are labeled manually.

- Train a binary classifier by decision tree.
  - Ten fold cross-validation

Promotion Identification (cont.)

- Training with ten fold cross-validation

Class	Number	Precision	Recall	F-measure
No Promotion	385	0.907	0.94	0.923
Promotion	163	0.846	0.773	0.808
Weighted Average	**548**	**0.889**	**0.891**	**0.889**

- The accuracy for 100 testing examples is 0.94.

Effectiveness Metrics	Relevant	Non-Relevant
Retrieved	47	2
Not Retrieved	3	48

Product Category Classification

- Five categories extraction
  - Delicacies, Clothing, Residence, Transportation, life service
- Training data preparation
  - Define some query keywords for each category (except for the last category: life service)
  - Positive: retrieve top relevant ads and label them manually
  - Negative: select randomly
  - Around 300 training examples including equal number of positive and negative examples

Product Category Classification

- Train a binary classifier for each category except for others

  - Ten fold cross-validation

- Annotate an ad as life service if it is not classified to each category

Category Prediction Performance

- Training with ten fold cross-validation

Class	#Examples	Precision	Recall	F-measure
Delicacies	313	0.911	0.911	0.911
Clothing	302	0.984	0.983	0.983
Residence	302	0.815	0.815	0.814
Transportation	302	0.931	0.93	0.930

Simulation Platform

- The simulation platform is the web site, which was written in HTML, Java Script and PHP.

- Recommending mobile ads was calculated immediately

- The environment was assumed with GPS

- We assumed that user was moving with a velocity.

- Simulated platform couldn't simulate time interval, so we use steps within a route instead.
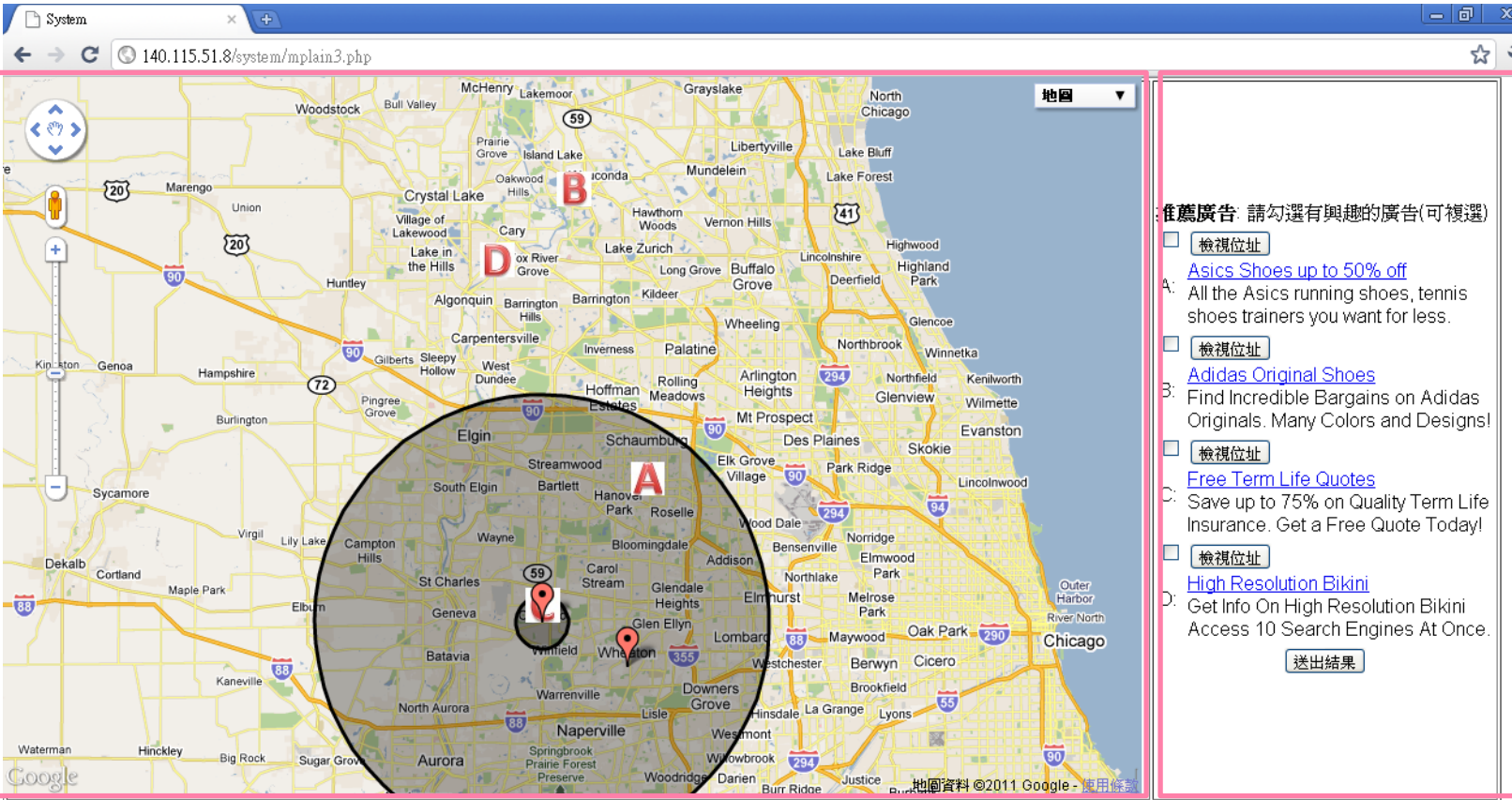
Simulation Platform (cont.)

- Scenarios

  - Case 1: travel from point A to point B.

  - Case 2: Sighting seeing around point A.

    (around here)

Simulation Platform (cont.)

http://140.115.51.8/system/index.php

Performance Evaluation

- 30 subjects
- Each with 20-25 runs of tests
- Precision, recall and F-measure are computed for each user.
- The result shows the average over the users.

- Precision

$$P(u) = \frac{|A \cap B|}{|A|} = CTR \text{ (Click Through Rate)}$$

- Recall

$$R(u) = \frac{|A \cap B|}{|B|}$$

  - A: the numbers of ads recommended to a user
  - B: the numbers of ads clicked by a user
  - F-measure is computed as normal.

Performance Evaluation (cont.)

- Performance

Approach	Precision	Recall	F-measure
Locality + User Information	0.494	0.369	0.401
User Information	0.428	0.311	0.343
Locality	0.310	0.199	0.232
Random	0.200	0.118	0.141

Conclusion

- The framework: a triple-win for the telecom carriers, the mobile advertisers and the subscribers

- Our system recommends mobile ads based on the factors of accessibility and content-match.

- Mobile advertising is important for geo-/ deep- / behavior- targeting

Future Work

- Advertising based on history or collaborative filtering can be explored to increase advertising effectiveness.

- Click fraud prevention is important for such services

Thanks for your time !